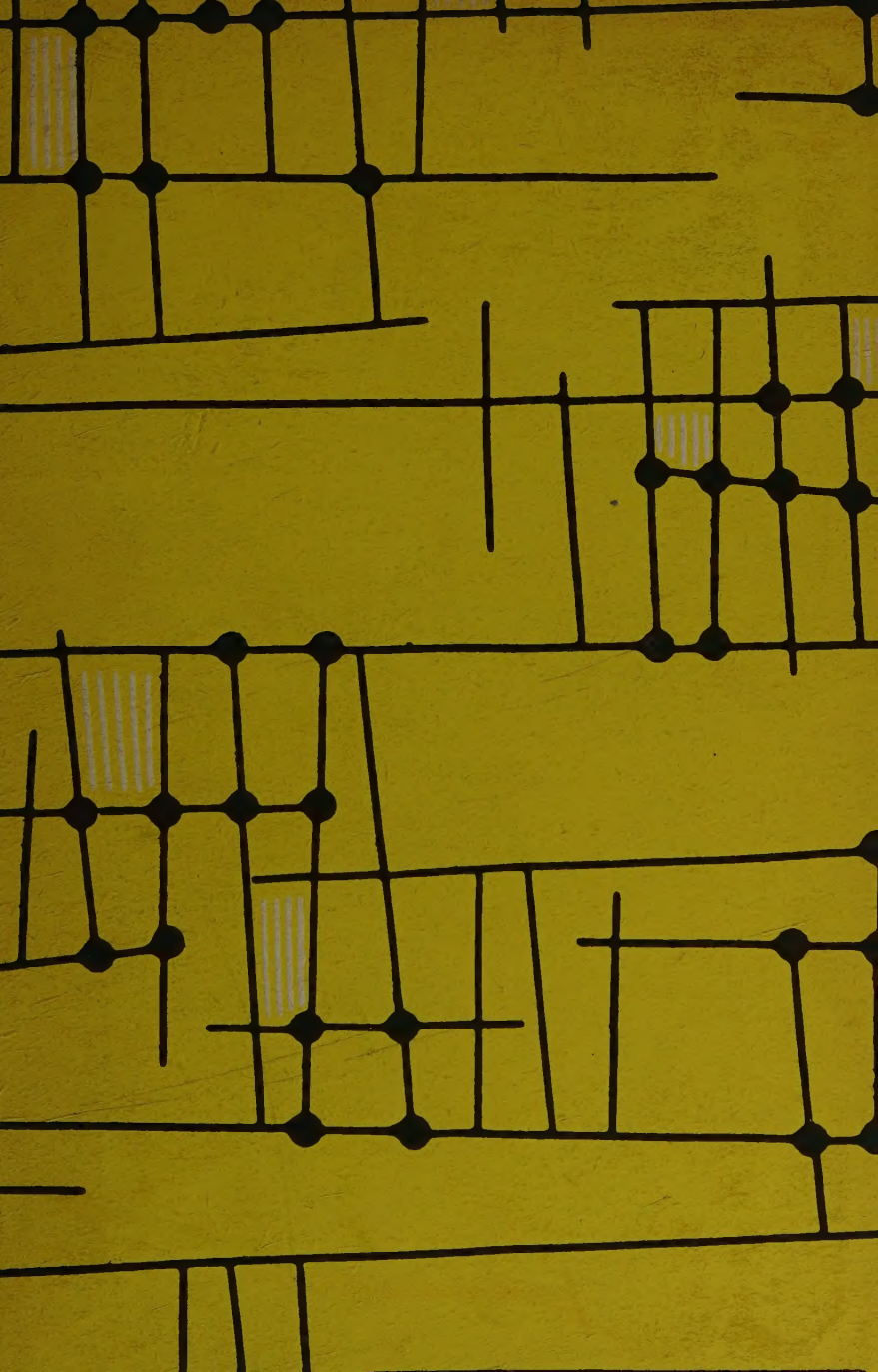

# GUIDE

TO

# METHODS OF INSECT LIFE;

AND

PREVENTION AND REMEDY OF INSECT RAVAGE.

## Being Ten Lectures,

BY

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1884.

TO

THE MANY FRIENDS

TO WHOM I AM INDEBTED FOR HELP AND ENCOURAGEMENT IN MY WORK

This Little Volume

IS GRATEFULLY INSCRIBED

BY

THE WRITER.

# PREFACE.

The Lectures contained in this little volume were written at the request of the Institute of Agriculture that I should prepare some information on the habits, and means of prevention, of crop insects, such as might be generally useful.

A long preface would be out of place to such a little book; but I wish just to mention that though I have undertaken the work with considerable uneasiness, as I know well that it requires far greater knowledge than I possess to carry it out fully, yet I have endeavoured by all means in my power to ensure accuracy; and if the following pages prove of any service I shall be very glad.

The book is formed in the hope that it may be taken to the field, or taken up at an odd minute, and give a little information without burdening the reader with a need of looking elsewhere for explanations. I have therefore, as far as possible, throughout used only the

words of our own language; and for the explanations of such *scientific* terms as are used, or for the *scientific names* of the insects figured, the reader is referred to the Glossary and to the List of Insects.

Also, as mere word description often entirely fails to give any idea of the appearance of an unknown animal, I have (as far as I could) given figures of the insects referred to, instead of long technical descriptions.

For a large proportion of these I now, as often before, express my obligations to the courtesy of Messrs. Blackie & Son, Glasgow, for allowing me an extended use of electros (and also additional ones) from the beautiful figures by John Curtis, published in his 'Farm Insects.' I also acknowledge with thanks the use of figures from Newman's 'British Moths,' allowed me by Mr. Allen; and also some figures kindly lent me by Mr. T. P. Newman, from the 'Entomologist' and elsewhere.

Of the remainder of the illustrations several of the single figures of Beetles are after representations in the plates of the 'Kaferbuch,' by C. Calwer; the Bee Parasite (which is rarely figured) is after a drawing by Prof. J. O. Westwood; and some are by myself.

In the direct history of Insect metamorphoses, I have benefited much by the 'Introduction to Classification

of Insects,' by Prof. J. O. Westwood, Life-President of the Entomological Society, to whose friendship and assistance I have been greatly indebted for many years; and amongst other works, from which I have condensed information for this little book, I acknowledge with thanks much benefit from the following publications:—'British Aphides,' by G. B. Buckton, F.R.S.; 'British Beetles,' by E. C. Rye; 'British Phytophagous Hymenoptera' (Sawflies, &c.), by P. Cameron; 'Fauna Austriaca,' *Fliegen* (two-winged Flies), by Dr. J. R. Schiner; and also assistance from the 'Report on Scale Insects,' recently published by J. H. Comstock, Prof. of Entomology, Cornell University, U.S.A.

The methods of prevention are mainly taken from the observations, which I have now for many years had the honour to receive for my yearly Reports, from a large number of our agriculturists, as to treatment found practicable at a paying rate; and I gratefully acknowledge the kind help I constantly receive from all the many friends interested in the work of prevention of Insect ravages.

ELEANOR A. ORMEROD.

Dunster Lodge, near Isleworth,
*December, 1883.*

# LIST OF ENGRAVINGS ON WOOD.

*The description being given with the English name to each figure, the scientific name alone is given in the following List.*

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## LECTURE II.



## LECTURE III.

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### GLOSSARY.



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# GUIDE

TO

# METHODS OF INSECT LIFE.

## LECTURE I.

### EGGS, CATERPILLARS, &c.


Fig. 1.—Common Dart Moth: 1, moth; 2, caterpillar.

I THINK that we cannot begin our work better than by considering, firstly, what an insect is;—what the special points are by which we may know whether what we are looking at is an insect or not. We all know this in a general way: we know that a Wasp or a Fly, a Beetle or a Butterfly, is in each case an insect, and that insects begin their lives by being either produced alive or hatched from an egg as maggots or caterpillars, or in some other wingless shape; and that gradually, through various changes in the nature of the inside organs, and changes of appearance caused by moults of the outer skin, they alter to the state of the perfect insect. But

we will take the precise description, and then form this dry beginning into something alive and serviceable.

An insect is "an annulose animal," breathing by means of air-tubes running through every part of its structure, and known as tracheæ; changing by a series of moults to its perfect state, in which it is provided with a distinct head bearing horns (known as antennæ), and it has three pairs of jointed legs, and (commonly) two pairs of wings.

Let us go over this point by point. Insects not having any bones, that is not having an inside skeleton, need an outside skeleton or support to keep them together. This is formed of a succession of rings, often of a horny texture, as you may see in a Wasp when it has been crushed on a window-pane; and the rings are commonly about thirteen in number. One of these rings forms the head, the three next support the legs and wings, and the remaining rings or segments form the abdomen, and contain a portion of the organs of digestion and those of reproduction. Thus an insect is formed of rings: it is, scientifically speaking, annulose.

Fig. 2.—Hornet.

Next—*Insects breathe by means of tracheæ.* These tracheæ are air-tubes communicating with the air by means of small openings or mouths of various shapes, called *spiracles*,* because through them *respiration*, or breathing, is carried on. They are generally placed at regular distances along the side of the insect. Fig. 3 shows the spiracles on the sides of the caterpillar and chrysalis of the Yellow Underwing Moth; but sometimes, especially in the case of Fly maggots, which live in putrid matter or wet places, the spiracles are at the

* From *Spiro*, to breathe.

end of the tail, or near it. Thus the maggot can live in the moisture that suits it, and yet draw in air by means of the exposed tip of the tail.

The various air-tubes (*tracheæ*) start from each spiracle, and then by means of branches, which often join so as to form a net-work, they carry the air through every part of the insect,—limbs, body, and intestines. Insects do not draw in air through one mouth, as we do, neither have they lungs, but (commonly by means of the spiracles) the air-tubes bring the action of the air to bear on

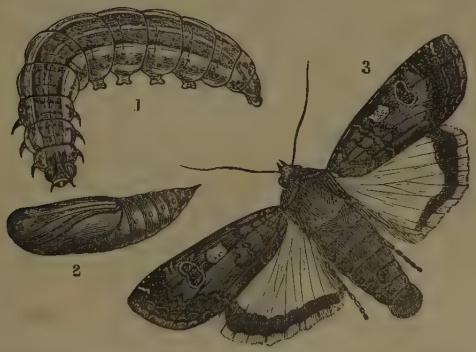


Fig. 3.—Yellow Underwing Moth: 1, caterpillar; 2, chrysalis; 3, moth.

the fluid answering to blood, which fills the hollow body of the insect. This fluid is not carried in veins, as with us, but bathes the intestines, the air-tubes, and all the viscera of the insect; and thus is affected by the passage of the air through it.

This method of breathing is very requisite to know about for practical purposes, for if the breathing-pores are choked the insect dies. The fact of its head being free is of no service, for the chief use of the head is for feeding or seeing with; but if the caterpillar or insect is so treated by being turned out from its natural home, or by being covered with any sticky dressing that its breathing-pores are choked, it dies; and in this way we can act on some of our crop pests. But though an

insect has through life these two special points (that is to say, of being formed of a succession of rings, and breathing by air-tubes) by which it may be known in some degree, yet also, in many cases, as its term of life goes on, it alters very much in appearance from what it was at first. Just as is the case with most others, of at least the higher orders, of the animal creation; each one is in some degree different in shape and appearance, and also in structure of internal organs, in its early life and in its mature state. But there is this remarkable point to be observed, that whereas with many animals the alteration goes on so gradually, from birth to mature life, that we do not see any sudden change, in the case of insects the change of *appearance* is often very rapid. The alteration itself goes on gradually, but from the moult of the skin (such as that of the caterpillar showing the chysalis within it), often taking place in a very few minutes, the difference in appearance of the insect is often, to those not used to the matter, most astonishingly sudden, and gives rise to all kinds of unfounded ideas. These changes, which happen according to regular laws, are what are known as the "*metamorphoses*," or "transformations" of insects, because the insect is then, as it were, "metamorphosed" or "transformed" from one condition to another.

*Insects pass their lives in three different conditions*, after they have been hatched from the egg or produced alive by the parent. The first of these is that of the caterpillar, maggot or grub (or, to speak scientifically, the *larva*), in which the creature feeds voraciously, often grows fast, and has *no wings*. The second is that of the chrysalis or pupa, in which the wings and complete internal organisation is forming. The third state is that of the perfect insect, or imago, with all its limbs and powers complete. This is the common course of insect-life through its transformations after being produced alive, or hatched from the egg, larva, pupa, perfect insect, or imago.

But before going on with the subject it will be well,

with a view both to learning and teaching with comfort, to consider in what words a knowledge of insect-life may be most simply and clearly, as well as correctly, conveyed. As a general rule, for all practical purposes, it will be best, as far as possible, only to use words which will be at once understood. This puts it in the power of all, whether they have a knowledge of the subject before or not, to give their whole attention to what is being said (or being taught, in the case of our pupils) without being disturbed by having to recall the meaning of each new word each time it recurs. Thus, whilst on one side instructions can be given much more satifactorily, on the other they will bear fruit much more surely, for the hearers will be able to pursue the subject comfortably

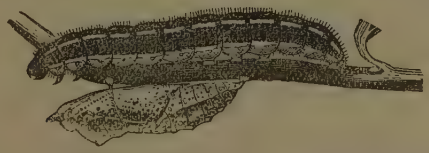

FIG. 4.—Caterpillar and chrysalis of Large Cabbage Butterfly.

amongst themselves without shyness or ridiculous mistakes, or the fear of rough banter, which holds back many a learner from using a technical word out of class.

I would therefore advise, with regard to insect knowledge for farm use, that wherever an English word has a well-known meaning, and may correctly and properly be used, you should use it, rather than the scientific one. If the *larvæ* of Flies are called "maggots," or the larvæ of Butterflies "caterpillars," few people in the country will fail to know what is meant; but if we wish to speak of the first stage of Flies and Butterflies, and other insects together, then we must use the scientific word, and speak of them as larvæ, giving careful explanation.

*Larva* is a Latin word, meaning a ghost or phantom, and was applied by Linnæus to the first stage of insect-life, from an idea of this being a kind of phantom-like shadowing-out of the real or complete state. It is a very

fanciful idea; but the term *larva* having been adopted for the first stage of all insects, we cannot help ourselves about it.

*Pupa* is a Latin word, describing young animals not yet complete in their organisation; therefore it is very suitable to the state in which the complete insect is forming. This stage is also often known, especially in Butterflies and Moths, as the *chrysalis* state, from a Greek word, signifying golden, some chrysalids being of a bright gold-colour.

Fig. 5.—Larva and pupa of Cockchafer.

*Imago* is the Latin for an image, or representation, and is used for any kind of insect in its complete state, —a Fly, or a Beetle, or a Grasshopper, for instance, is an imago.

Any insect in its first state is a *Larva*, any insect in its second state is a *Pupa* or *Chrysalis*, and any insect in its third state is an *Imago*.

If we now trace these changes forward from the beginning you will be able to prove them for yourselves, as a matter of living serviceable fact, which may be given as solid instruction where needed, and also as practical information fit for a reasonable man to receive, to the many who depend on the food-crops for their livelihood, and who will thankfully accept all reliable aid that may tend to lessen their yearly losses through insect attack.

The regular order of the progress of insect-life is—1st, *larvæ* hatched from eggs, or produced alive; 2ndly, *pupæ*, in which state the larvæ change to their full powers; 3rdly, *imagos*, that is, the insect in its perfect state, in which it usually has wings.

Insect eggs are of various shapes: they may be round, or oval; conical, or pear-shaped, or other form; sometimes, as seen under a magnifying-glass, they are beautifully marked with stripes, net-work, or other patterns; they also differ in the nature of the outer coat, which sometimes is hard and crisp, sometimes a mere flexible film. These eggs are, for the most part, laid by the parent insect on, in, or near the substance, be it plant or animal, which is to be the food of the maggot or other kind of larva which will presently hatch from them. Sometimes the eggs are laid in


FIG. 6.—1, Eggs of Beet-fly; 2 & 3, eggs of Butterfly, magnified.

places from which they will be carried to where the grubs that hatch from them will be in a suitable place for feeding. The Horse Bot-fly, for instance, lays her eggs on the horse, and by means of the animal (or another) licking them off they are carried to the stomach. But whether they begin life by coming out of an egg, or are produced alive, *insects always begin life by being produced by a female insect.* It depends on the nature of their kind whether they are hatched, as with Moths, Butterflies, Beetles, Sawflies, and many other kinds; or are produced alive, as is sometimes the case with Flies, or with many kinds of Aphides, during the summer, but they are never engendered spontaneously, or from putrid matter of any sort. They are often to be seen coming out of such matter, and the grubs are to be found in it: this is the reason of the common idea that insects are "bred," as it is phrased, by putrid substances and stagnant water. The insects are plainly to be seen coming from filth of all kinds,—

rotten carcases and animal excrement, or putrid meat, fruit, and vegetables, and these things swarm with maggots; but unfortunately it is not often so plainly noticed that the parent insects were there, and the eggs laid as a beginning of the attack. This is a point very necessary to prove plainly, as it has an important bearing on insect prevention.

To show that eggs really are in insects we can take females, when about to lay, and shut them up in a box, so as to show the various shaped eggs, which various kinds, such as Beetles or Moths, or others, produce. Also we can kill some of these females, and by opening them show the eggs within,—some just ready to be laid, some not so far advanced.

We can show that water, bones, cattle-droppings, and the like, do not themselves breed insects, by securing them in such way that there is no possibility of access of insects; and thus (if the experiment has been properly made) the material will putrefy or dry away without insect attack. On the other hand, we can show how these things attract the insects that start attack, by noticing Gnats laying their masses of eggs ("egg-boats," as they are termed) on stagnant water; Blowflies laying their eggs, or even their hatching maggots, on meat, bones, or carcases; Beetles laying their eggs in dead animals or cattle-droppings, or in decayed wood; and with a little watching the grubs will be found hatching according to the nature of their parents.

This is an important matter to have quite right, for it sometimes happens that there is an uneasiness as to whether various kinds of crop attack are set on foot by insects brought with manure; and whilst we are very safe from bones or dung "breeding" them, it may very likely be that some kinds of grubs will go on from vegetable, or partly vegetable, manure to the growing crops.

The growth of a grub before hatching may be watched by taking an egg, partly advanced towards maturity, and laying it on the stage of a microscope. If you get a transparent one, such as that of the Turnip-blossom

Beetle (*Meligethes æneus*), you will be able to see the grub within growing, day by day, until it gradually bursts the thin skin of the egg, and walks out of it as a complete grub, with claw-feet, head, and jaws. Thus the history may be shown so far: we may find eggs within the female, see them laid, see the larva grow within them, and see it step out of them, often, if not always, ready to attack its appointed food, whether vegetable or animal,—in some cases a live specimen of its own kind.

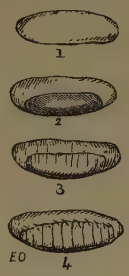


FIG. 7.—Eggs (mag.) of Turnip-blossom Beetle.

*Larvæ*—that is to say, insects in their first stages—may be divided into two kinds. One kind, such as Locusts, Crickets, Earwigs, Aphides, and some others, are *very like* the perfect insect, to which they will presently change, in all respects, excepting being smaller, in gradually increasing in size, and in being wingless. The other kind we know as maggots, grubs, or caterpillars, are *quite unlike* the

FIG. 8.—Larva of Locust.


FIG. 9.—1 and 2, Field Chafer; 3 and 4, Garden Chafer, nat. size and magnified; 5, grub of Garden Chafer.

Beetles, or Wasps, or Flies, or other insects, to which they will change in due time.

We know pretty well what they look like without a description, but they may be said to be usually long, narrow, soft, and cylindrical. The rings, or successive segments of which they are formed, often show very plainly; the head (or the soft mass which serves the purpose in some maggots) is furnished with jaws or hooks, or some means of gathering up food, and sometimes with eyes and horns, and according to their kind

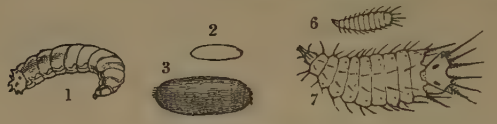


Fig. 10.—1, 6 and 7, larvæ; 2 and 3, pupæ of Flies, nat. size and mag.*

they are legless, or have a pair of short jointed legs on each of the segments behind the head, or in addition a pair of sucker-feet suited for holding by, at the end of the tail, and from one to seven pairs of sucker-feet beneath the body. By some one or other of these points they may be easily known from earth-worms, centipedes, millepedes, wood-lice, and the other small creatures that infest the same kind of places.

Insect larvæ feed on almost every kind of animal and vegetable substance, fresh or putrid, and also in stagnant water; but wherever they live, or however they may differ in appearance, they seem all to be alike in being most voracious in their appetites. They eat and grow, until the skin not being able to stretch further they pause in feeding for a while; the outer skin becomes loose, and is thrown off, or moulted, as it is termed. In the case of Grasshoppers, or insects nearly alike in the larval and in the perfect state, this change is a wonderful process, for the young insect has to free itself of the outer coat of its long slender limbs, and of all its outer surface, as completely as the thick fleshy

* For figures of larvæ, see following Lectures.

grub or caterpillar, which sometimes, by taking firm hold with the pair of sucker-feet at the end of the tail, can drag itself much more easily out of its cast clothing. When the moult is completed the larva eats again. This progress goes on according to weather, and other circumstances, until the larvæ have reached their full growth; this may be in a few weeks or months, or it may not be for three, four, or even five years. Then an internal change takes place, and the young insect leaves off feeding; and then in the case of the "similarly changing" insects, such as Grasshoppers, Plant-bugs,

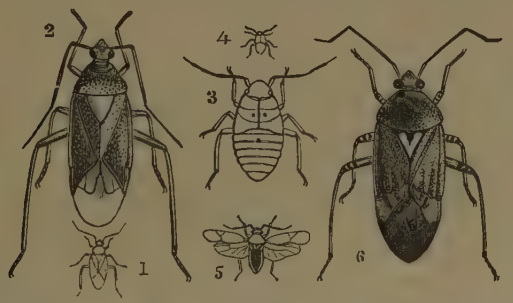


FIG. 11.—1 and 2, Potato-bug; 3 and 4, pupæ of ditto, nat. size and magnified; 5 and 6, Hop-bug, nat. size and magnified.

and some others, the larva, for the last time in its larval life, draws itself, limb by limb, out of its dead skin, and stands as a pupa. The skin having been shed, we see that it has now advanced towards the second stage, showing some advance towards wings and wing-cases, in such kinds of insects as have them when perfect.

In the case of the various larvæ, such as maggots, grubs, and caterpillars, which are "dissimilarly changing" insects, that is, in which the first stage is quite different from the two that follow, the larva, when it is going to turn to the pupa or chrysalis, commonly seeks some place, or makes use of some natural shelter, where it can lie securely during the time which it must pass inactive and defenceless whilst it is going through the

pupal state, and there it casts its larval coat for the last time, and appears from within as a pupa or chrysalis. These various changes are not mere matters of curious enquiry, but can be used very serviceably.

The insects, if they can, lay their eggs where the larvæ which come out from them will be able to feed at once; therefore we may prevent a great deal of coming attack by clearing away the large amount of weeds which many kinds of insect larvæ feed on as well as the cultivated crops; and thus we greatly lessen attraction for the insects to the neighbourhood. On the same principle pasture land is dressed, or sheep folded, to keep off egg-laying; or ground is drained where special pests prefer wet land. We shall take these various points in detail presently, but meanwhile we see how the general life-history of insects is useful, as showing how we can bring general principles to bear on them.

The caterpillar, or grub, feeds voraciously; and if there is nothing for it to feed on it soon dies. This is another reason for thorough cleaning of arable land. Many of the common weeds, such as Charlock, Couch-grass, and also some of the marsh-weeds, keep various of our pests alive and thriving, especially in spring, till there is crop-food for them; therefore, if we bear in mind that if these voracious appetites are not supplied the grubs die, we shall remember better to have the fields cleaned.

The point of the caterpillar changing its coat from time to time is sometimes most serviceably worked forward, as in the case of the Turnip Sawfly, which cannot quit its skin unless it is firmly fixed by the tail of the old one; if it cannot drag itself out, it perishes in the stifling wrapping of its late coat. This knowledge is utilised by brushing, or driving sheep through the attacked fields, and thus by simply loosening the hold of a destructive pest we save much of the crop.

Caterpillars will bear a great amount of cold without any injury, so long as they remain where they have placed themselves for the winter. Some will bear being

frozen hard without the least injury; but if they are disturbed from their cells under the surface of the ground, and left exposed to freezing in wet loose soil, then they perish. What the exact reason of this may be I do not know; probably many points act together,—

Fig. 12.—Sawfly caterpillars destroying Turnip-leaf.

the choking of the breathing-pores for one thing, the drying up when exposed to wind for another, and also the starvation of the creature if it wakes up from its sleep in such circumstances. But however this may be, if we know the habit of some caterpillars to be helpless and torpid during winter, we can readily act on it.

But though larvæ will bear great cold, yet the size, the colour, and the date of the appearance, and also the

presence or total absence of some kinds of insects, has been found to depend greatly on difference in weather influence, and amongst other things, as in the case of the well-known Colorado Beetle, on amount of cold and height above sea-level; and in the fact of the hordes of insects, which fairly sweep all before them on the great continents, being suited for the climates where they are found, but not for the constant change of our island weather, we have a good reason for not fearing their attack.

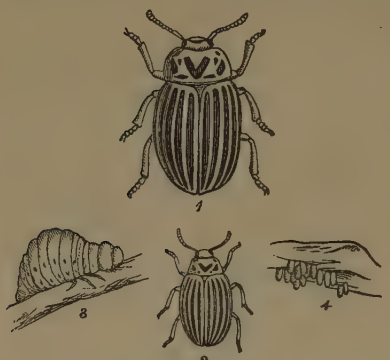


FIG. 13.—1 and 2, Colorado Beetle, magnified and natural size; 3, caterpillar; 4, eggs.

The shelters which caterpillars and grubs of various kinds make for themselves to turn to the chrysalis in, or to shelter in during winter, are of many kinds. Some caterpillars, like those of the silkworm, have then the power of secreting a gummy fluid, and by means of drawing this from their mouths they can spin silken cocoons, within which they slip, or rather shuffle, off their old caterpillar-skin, and turn to chrysalids; others (as some of the common White Cabbage caterpillars) hang themselves up by a strong spun thread passed round them, which acts as a band to keep them from falling; and many of the crop-feeding kinds simply hollow a cell in the ground, in which they lie protected from moisture and sudden changes of temperature; many Fly maggots contract, and as the outer skin gradually hardens it forms a safe case for the fly forming in its pupa state within. But whether the Beetle grub, or Fly maggot, or Moth caterpillar, they, as a rule, seek or make use of some kind of shelter; and if we know what, and where

this is, we can do much to lessen the great numbers, in which otherwise we are sure to find the crop-insect will collect where their food is to be found.

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# LECTURE II.

## CHRYSALIS—PERFECT INSECT—ORDERS.

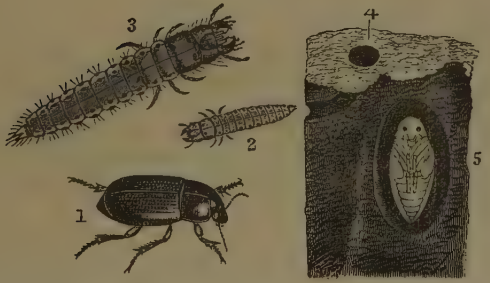


FIG. 14.—1, Corn Ground Beetle; 2 and 3, grub, nat. size and magnified 4, burrow of grub; 5, chrysalis.

WE have just spoken of how, when the grub or caterpillar (or *larva*, to use the term which includes the first stage of life of all insects) has completed this first feeding period of its life, it throws off its skin once more, and appears as a *pupa* or chrysalis; also that in many instances, and especially of those insects which lie inactive and defenceless whilst in the chrysalis shape, the grub spins, or hollows out, or in some way avails itself of some kind of shelter for the coming need of it. Here the change, which was beginning when the larva took shelter, is gradually completed.

The figures above show the change that takes place in the case of the Corn Ground Beetle, and also in the Heart and Dart Cabbage and Turnip Moth. The form of the creature, which was contained in the caterpillar or grub or maggot-skin, alters; the legs, the wings, the mouth apparatus, and all the other parts which the insect will possess in its perfect state, develop, until within the old dead caterpillar-skin, or within the contracted skin of some kinds of Fly maggots, there lies a distinctly differently shaped creature. The change is gradual; but the operation by which the chrysalis casts

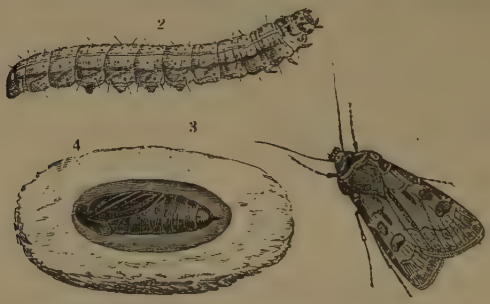


FIG. 15.—1, Heart and Dart Moth; 2, caterpillar; 3 and 4, chrysalis in earth-cell.

off its useless coat, and appears in its changed state, is often the work of a very few minutes. You may see this easily with some butterfly caterpillars, and especially with the spiny black and white-spotted caterpillars of the Peacock Butterfly, which may often be found in large numbers on Nettles. When these are ready to change they will fasten themselves up by the pair of sucker-feet at the tip of the tail to web spun on anything convenient. There they hang head downwards; and after much wriggling and twisting the black skin splits, and is gradually rolled by the muscular struggles of the chrysalis within it up to the tail, the bright shiny green of the chrysalis allowing the exact progress of operations to be very clearly seen. In a short time the old skin is

completely rolled up to the end of the tail, and the green moist chrysalis hangs as a defenceless body, but yet showing the shape of the legs, and wings, and mouth parts of the coming butterfly, where the black skin of the caterpillar, with its six claw-feet, hung a few minutes before. A kind of gummy secretion, which is given out, hardens over the surface, and preserves the insect forming within from injury.

Now to make sure how far development has advanced, it is a good plan to take one of the chrysalids, before the wet gum or cement on it has hardened, and to drop it into anything that will melt the forming cement away. I have used a mixture of warm turpentine and Canada balsam in a phial, as this keeps the specimen expanded afterwards. You will then see that the partially-formed limbs of the insect, or rather what would have developed to the insect but for us, are all there: the three pairs of legs, the still unexpanded wings, and the trunk or proboscis, which would have sucked honey from many a flower. It is well worth while to watch the process of change, and prepare a few specimens as above, for thus we can convince ourselves, and those we may have to speak to on the subject, as to what is the exact course and nature of one kind of transformation. The gummy covering gradually hardens, and within this the Butterfly or Moth forms and matures till its time for active life is come. Then it cracks the thin coat and steps out, the moist wings soon spread, and in a short time the insect occupies five or six times the space it did before, and is perfect.


FIG. 16.—Larva and chrysalis of Clover Weevil, nat. size and magnified.

The Beetle grub throws off its old skin, and lies as a pupa (or chrysalis) in galleries in the timber where the grub fed, or in the ground, or wherever its instinct may have taken it, inactive, but in appearance much like the Beetle, to which it will, with a very few exceptions,

presently turn. Only till complete in all powers, it lies with its limbs, usually in *separate* sheaths, beneath it.

The maggot of the Wasp, the Sawfly, the Gallfly, and others of the Wasp order, also change (as we may see in a piece of Wasp-comb) by turning to pupæ, in shape like the perfect insect, often in a cocoon, as with some Sawflies and Ants; in the cell where the grub fed, as with many Wasps and Bees; or in the Gall, which served the grub at once for food and shelter, as with many of the Oak and other Gall Flies. The Fly maggot changes to the pupa within the oval case formed of its hardened and contracted skin, or sometimes in an outer film, showing the shape of the limbs within (see Fig., p. 10, &c.).

Fig. 17.—Larva and pupa of Marble-gall Fly.

These different methods of change show the kind of transformations which the *dissimilarly* changing insects go through; that is, the insects which are what we know as grubs, maggots, or caterpillars, in their first stages. They leave off eating; many of the caterpillars leave the place where they were feeding, and consequently it is often thought the mischief is over, whereas it is only a lull while the storm is brewing to beat still harder. It is also to be observed that many of the brightly coloured caterpillars, such as that of the Death's-head Moth, alter in colour to a livid dirty tint when they are about to leave their food-plant, and thus the protection often given them by their likeness in colour to the leafage is continued until they are in their new shelter.

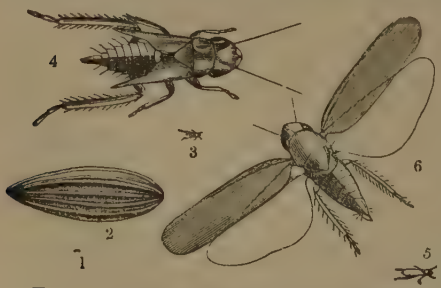


Fig. 18.—1 and 2, eggs; 3 and 4, pupæ; 5 and 6, Frog Flies: nat. size and magnified.

In the case of the Grasshoppers, Aphides, or other

insects, known as the "similarly changing," which differ little in appearance and little in habits throughout the three stages of their lives, the change is not so marked. When the insect moults its old skin it has to draw itself carefully, bit by bit, out of its neatly fitting coat. The conditions in the three stages are difficult to distinguish clearly in some of these insects, particularly in Aphides; but without entering on internal organisation, we know the three states, in a general way, as being that of *larvæ* whilst they are quite wingless, that of *pupæ* when the wing-cases and forming wings show more or less, and that of perfect insects or *imagos* when (with all kinds that have powers of flight) they have their wings complete.

When the insect has come out from the chrysalis or pupa, it is perfect; it will grow no more, excepting from its wings expanding in some kinds (as with Moths and Butterflies) in which they were not fully spread, or were folded tightly in the chrysalis case. The internal organs are now also perfect, and its remaining work is to propagate its species.

Many kinds, which have been ruining our crops for months as voracious grubs, are now harmless during the short remainder of their lives; but some, on the contrary, of our worst crop-pests, such as the Turnip and Mustard Beetle, live through the winter, and ravage in their perfect state as badly, or worse than they did in their first stages. These points, or points such as these, regarding the condition of insects at different times in the year, and their general habits, are what we need to know about much more than their special structure. But there are more ways than one of gaining this information. If we can do it by watching the habits, this is best; but also if we have enough book knowledge of insects to be able to tell generally whether any special grub will continue to trouble us in its perfect state, or whether some flock of insects will be followed by a plague of grubs, from eggs they have laid, it cannot be denied that the knowledge is very useful.

Therefore, before going on to field observations, it will be serviceable to take notice of some points of structure which all perfect insects possess in common; and afterwards to see how, by some few and very clear differences, noticed together with the different transformations of which we have just been speaking, we may tell what order an insect belongs to, and thus get a general idea of its habits. I trust to be able to show that by mastering a few simple details we may gain all the knowledge we want, as a foundation, either for field use or to carry on further study of insect life with scientifically, if we wish.

A perfect insect has a head and body; the body is divided into the fore and the hinder body. When the insect has its full number of limbs the fore body (or *thorax*) bears, or is borne, by three pairs of legs and two pairs of wings; the hinder body (*abdomen*) contains a large part of the intestines and other organs of digestion, and those of reproduction. The head is distinct from the body, and has a pair of horns (*antennæ*); and seeing-powers of two kinds. These are compound and simple eyes. The compound eyes are formed of a large number of lenses or facets, forming together an immovable mass, sometimes occupying nearly the whole of each side of the head. The simple eyes are each a single lens. These are little specks placed on the crown of the head, or thereabouts, and are very few in number; I am not aware that there are ever more than three, and some insects are without them. The mouth and feeding apparatus, though it looks so different in different insects, is considered to be made up of the same six parts in all. These are an upper and an under lip, and two pairs of jaws, which in the biting insects work from side to side (laterally, not vertically)

Fig. 19.—Hornet Clear-wing.

between the lips. The upper pair of jaws (*mandibles*) is often strong and horny; the lower pair, or "feeler" jaws (*maxillæ*), takes its name from having feelers (*palpi*), as has also the lower lip. These parts of the mouth vary very much in shape, as we may see in the trunk of a Moth, or the proboscis of a Fly; but still these differences are considered to be in every case only varieties in the general form we just noticed. Every one of these parts has a scientific name; and throughout the insect there is probably not a point which can be observed by powerful magnifying glasses which has not a special scientific name; but this *we* need not trouble ourselves about. Here we reap the benefit of the careful labour of others.

It is not now, as it was some fifty years ago, when "general views" on this matter were "general" from want of knowledge. Now the minute descriptions, and thoroughly worked out distinctions and resemblances in appearance and habits, which have for many years been more and more placed at our service, enable us to have the "general views" of good knowledge. We see and can prove that many kinds of some one sort (or *genus*) of insect, though they may differ a little in shape or colour, yet are alike in their methods of life, and in the methods also by which we may check them. We are, therefore, taking no loose idle view in classing them together, and in thus thinking of, and speaking of, Turnip Flea Beetles, or Wireworms, or Daddy Longlegs, as at work, without troubling ourselves as to their special name.

If we have to write or speak to naturalists of other countries, or if we speak of minute divisions, only seen by scientific means, then we need special scientific words. But for the matters of field work, which we speak of daily, and see with our own unassisted eyes, it is much the best way to use words which will be understood at once by all around us. This may generally be managed with regard to the insect by taking the word which would be used for the same part in other animals; and this course has been in part adopted by our best

entomologists. If we speak of the horns, or (with regard to the legs) of the thigh, shank, and foot, everyone will know what we mean; and the only real difficulty in *our* branch of the work seems to get a counterpart in English for the word *thorax*. This is the fore part of the body, and the word trunk was used formerly for it; but now this word is used for a portion of the mouth: but we may speak of parts of it, such as shoulders and breast; and possibly, where *thorax* would not be understood, the term "fore-body" might serve.

We need to have just such a kind of knowledge of the crop insects as we have of the crops; and for field purposes it is enough for each grower to know, by the kind of injury to the crop, taken together with the appearance of the insect injuring it, what it is that is at work, and thus be able to tell, or ask for, the method of prevention of its ravages; or, if he prefers, by having a book at hand, and simply looking out the crop in the index, and then turning to Peas, or Beet, or whatever it may be, he will most likely, if it is any kind of attack commonly injurious to a serious extent, see a figure, history, and account of the best known means of prevention or remedy.

But in our present study we are aiming at something more. We wish to gain enough information to be able to tell which of the large divisions (*orders*, that is) of insects whatever insect we may be observing belongs to, because thus at once we shall know many of the chief points of its history. We shall know what changes it will pass through, which is a very useful piece of information; and if once we have the chief points of distinction of the orders firmly fixed, we have a true foundation, on which we may build up any further knowledge. This is not by any means a difficult matter.

In the following pages I have placed the thirteen Orders of Insects in groups,—not according to what I believe is the usual Entomological arrangement, but according to general characteristics, and to their importance to us agriculturally.

*Insects are divided into Orders, which are named according to the nature or number of their wings.* This difference in the wings occurs so regularly, along with difference in the nature of their changes before they were perfect, that thus you know their general history before they got their wings. A common two-winged Fly had, generally speaking, a legless grub, and so on.

Insects are divided into thirteen orders, and the scientific names of these all end in the word *ptera*, wings, from the Greek word *pteron*, a wing; and the previous part of each word describes the number or the form or the nature of the wings.

We need only trouble ourselves about such of the orders as are most important to us; but in case you wish to refer to scientific books, it will be well, firstly, to have the whole list of orders as it is often arranged:—

| WITH JAWS. | | WITH SUCKERS. |
|---|---|---|
| Coleoptera. | Neuroptera. | Lepidoptera. |
| Euplexoptera. | Trichoptera. | Homoptera. |
| Orthoptera. | Hymenoptera. | Heteroptera. |
| Thysanoptera. | Strepsiptera. | Aphaniptera. |
| | | Diptera. |

These have been placed in two divisions, according to whether they feed for the most part by means of jaws, working, as we just noticed, from side to side, like pincers held flat; or by means of a trunk, or sucker or piercer of some kind.

For our purposes, however, it will be much more convenient to take, first, those orders which are grubs, maggots, or caterpillars, in their first state, and arrange them, in succession, by the increase in the number of legs or sucker-feet of the grubs, and wings, or apparent wings, in each order. Next, the orders which are nearly alike in all their states, as Grasshoppers and others. Next, just to give a word to the orders which we need not trouble ourselves further about.

Firstly, then, we take the orders of FLIES; FLEAS; BEETLES; MOTHS and BUTTERFLIES; and the order which includes WASPS, SAWFLIES, ICHNEUMON FLIES, and many other Wasp-like Flies.

FIG. 20.—Cabbage and Potato Flies, magnified. (*Diptera.*)

FLIES (*Diptera*)—two-winged—have only two wings, and a pair of poisers instead of the hinder pair. These appendages are often pin-like in shape. Maggots almost invariably legless.

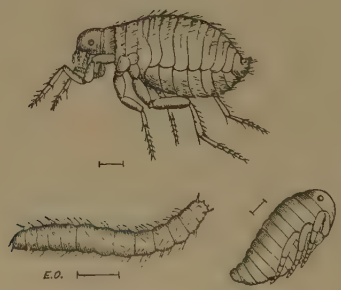


FIG. 21.—Flea, maggot, and pupa; magnified. (*Aphaniptera.*)

FLEAS (*Aphaniptera*)—imperceptible-winged—have no real wings, but with a good magnifying-glass they will be seen to have two pairs of scales, which have been considered to represent two pairs of wings. The grubs are legless.

Beetles (*Coleoptera*)—sheath-winged—have two pairs of wings, the upper pair horny, and thus forming a kind

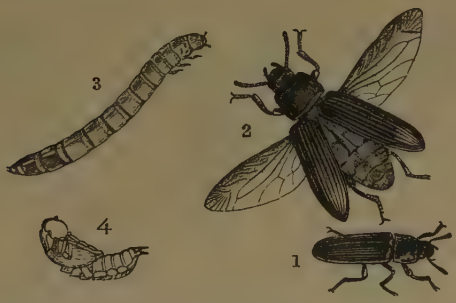


Fig. 22.—Mealworm Beetle, nat. size and magnified; grub and pupa. (*Coleoptera.*)

of "sheath" for the under wings. Grubs sometimes legless, sometimes with three pairs of feet, and a sucker-foot at the tip of the tail.

Fig. 23.—Buff-tip Moth: caterpillar and chrysalis. (*Lepidoptera.*)

Moths and Butterflies (*Lepidoptera*)—scale-winged—have four wings, usually covered with powdery dust,

which is formed of differently shaped scales. The caterpillars have commonly three pairs of claw-feet,

Fig. 24.—Large Cabbage Butterfly. (*Lepidoptera.*)

and a sucker-foot at the end of the tail, and also from one to four pairs of sucker-feet under the body.


Fig. 25.—Humble Bees. (*Hymenoptera.*)

Bees, Wasps, Sawflies, Gallflies, Ichneumon-flies, and others (*Hymenoptera*)—membrane-winged—have four transparent or thin wings, as if they were formed of a piece of membrane. The grubs are sometimes legless;

but those of the Sawflies, which are the grubs most injurious to plants in this order, have usually, besides


FIG. 26.—Turnip Sawfly, magnified; caterpillars, pupa, and pupa-case. (*Hymenoptera.*)

the three pairs of claw-feet, five to seven pairs of sucker-feet under the body, and a pair at the end of the tail.

We can enter more at length on points of distinction, which are of use practically, by-and-bye; but here we get a kind of foundation of knowledge about five of the most hurtful orders. We see that if there are large numbers of *legless* grubs in a field, it is likely they are of some kind of two-winged Fly; and again, if we see Daddy Longlegs much about, and notice they have only *two* wings, we shall look, and probably not be disappointed in looking, for an attack of their legless grubs. So on with others,—if we know enough for the *presence* of the insect in one stage to suggest that *it is coming* in another, it is a very serviceable amount of knowledge, even if it went no further.

We have just given a slight sketch of five orders, which are quite different in appearance in their three stages. Of the eight remaining, there are five orders in which the insects are nearly alike throughout their lives, and also in many cases troublesome to us: these

are the orders containing the Grasshoppers, Locusts and others; the Earwigs; the Aphides and others; the Plant-bugs; and the Thrips.

Fig. 27.—Locust. (*Orthoptera.*)

Locusts (*Orthoptera*) — straight-winged — have the under wings folded lengthwise, or straight beneath the upper pair.* (See note, p. 30.)

Fig. 28.—Earwig, with wings spread, magnified. (*Euplexoptera.*)

Earwigs (*Euplexoptera*)—tightly-folded winged—have the under wings so very large, compared to the small

upper pair (or wing-case), that they need to be very tightly folded to fit beneath them.* (See note, p. 30.)


FIG. 29.—Cabbage Aphis: male and wingless female, nat. size and magnified. (*Homoptera.*)

APHIDES, SCALE, &c. (*Homoptera*)—similar-winged—have the wings of the same nature throughout each or both of the two pairs of wings, in which they differ from the next order.* (See note, p. 30.)

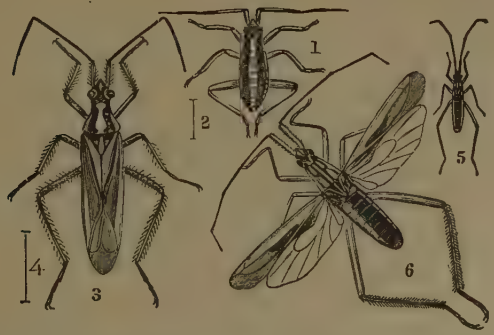


FIG. 30.—Wheat and Grass Bugs and pupa, magnified and nat. size. (*Heteroptera.*)

PLANT-BUGS (*Heteroptera*)—dissimilar-winged—have a part of the upper wing that is nearest to the body

dissimilar to the rest of the wing, which is membranous, as is also the lower wing.*

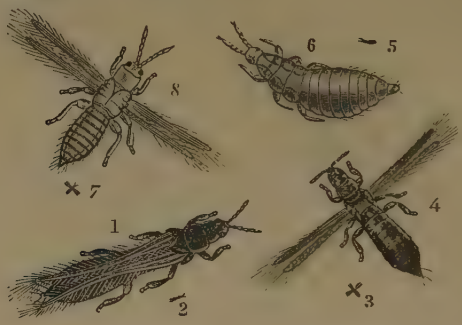


Fig. 31.—Thrips and wingless larva, nat. size and mag. (*Thysanoptera.*)

Thrips (*Thysanoptera*)—fringe-winged—are very small insects, with four narrow wings with fringes round the edges.*

The three remaining orders are those of Dragon Flies (*Neuroptera*), Caddis Flies (*Trichoptera*), and Bee Parasites (*Strepsiptera*), and need not be entered on; but I add a figure of Caddis Fly to show the general

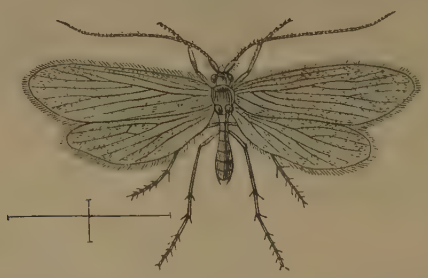

Fig. 32.—Caddis Fly, magnified. (*Trichoptera.*)

* In all the above five orders the insects in their first stage are very like what they are in the two after stages, excepting that they have neither wings nor wing-cases. For further illustrations, explanations, and exceptions, see the different orders in the following Lectures.

appearance, and also one of the Bee Parasite to show the peculiarity of the fore pair of wings, being only

Fig. 33.—Bee Parasite, magnified. (*Strepsiptera.*)

represented by a twisted growth. The Dragon Flies also do not need illustration; but the figure shows a small four-winged Fly of this order, which lays stalked


Fig. 34.—Golden Eye and stalked eggs, larva and cocoon, nat. size and magnified.* (*Neuroptera.*)

eggs, often found amongst Aphides, on which the "Golden Eye" grubs feed.

The above dry list is all I purpose to lay before you of mere scientific description, and this much we need as a foundation for building on; but I would not advise any agriculturist, unless he had a strong taste for the study, to burden himself with trying to make out mere scientific *minutiæ* as to points in their appearance.

The life-history is of the utmost practical importance; and I hope to show how to gain such knowledge as will

* The Dragon Fly is the best known of the *Neuroptera;* but the Golden Eye figured is directly useful to us by feeding on Aphides.

tell you where to seek for our crop pests in all their stages; what agricultural influences we can bring to bear on them; and how, by knowing in what form they pass the time when not at work, we may, with least expense and most surely, turn them out from their shelters: and, firstly, we will take the very injurious order of the *Diptera*, or two-winged Flies.

## LECTURE III.

### FLIES (*DIPTERA*).

### Daddy Longlegs, Wheat Midge, Carrot and Onion Flies, &c.


Fig. 35.—Daddy Longlegs: 1, larva; 2, pupa-case standing up in the ground; 3, fly; 4, eggs.

In our yesterday's Lecture I showed how we might tell, in a general way, to which order of Injurious Insects

any specimen which we might find in its perfect state belonged, simply by means of the nature or number of its wings; also how to turn our knowledge to serviceable account, we should be able to tell, generally, what the habits of the insects are, in whatever stage of their life we may meet with them, that so we may know how to get rid of attack, or support our crops under it. We will now consider the division of the Two-winged Flies.

This order includes the Gnats and Corn Midges, also the Daddy Longlegs, of which the grubs are so hurtful to many kinds of crops; the Blowflies, which cause great waste to meat in summer; the Gadflies, and a very large number of other kinds, which, by means of their maggots, do boundless damage year by year to the roots of Cabbage, Onions, and other garden-crops, and likewise to the heart or stem of the growing corn, and many other kinds of various habits.

All flies of this order have no more than one pair of wings; occasionally they are wingless. The hinder pair is represented by a pair of appendages, often like a slender pin with a small head. These are known as "poisers" (*halteres*), because they help, or appear to help, to poise or balance the insect. These insects feed by suction, some of them, as in the case of the Gnats, to our great annoyance.

The grubs are fleshy and (with few exceptions) footless;* sometimes, like the Daddy Longlegs grub, they have a hard head, furnished with nippers or jaws; sometimes they have a soft mass which answers for a head, commonly bearing a pair of hooks instead of jaws, with which they clear out the substance between the two sides of a Turnip-leaf, or from the inside of an Onion-bulb, or other soft material in which they may be feeding.

* The maggots of two kinds of Flies (*Eristalis* and *Helophilus*) are peculiar for possessing seven pairs of what may be called a kind of claw-like feet. These maggots are known as "rat-tailed larvæ," from the hinder part of the body being lengthened into a long slender tail like tube, whereby they can draw in air from above the damp or muddy places in which the maggots lie.

The pupa-case, or chrysalis, of the Gnats and Midges, Daddy Longlegs, and some others, is in shape much like the creature within, with its limbs folded; in many other kinds the pupa-case consists of the hardened maggot-skin, which shelters the forming fly within.

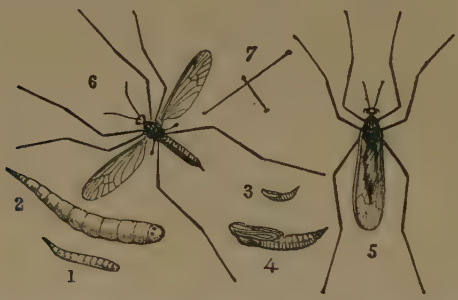


Fig. 36.—Winter Turnip Gnat: 1 and 2, grub;* 3 and 4, pupa, natural size and magnified.

The great division of the true Gnats (*Culicidæ*) and Daddy Longlegs (*Tipulidæ*), which also includes Wheat Midges, are mostly of Gnat-like shape, with long legs, and long horns, and their grubs are to be found in the most various localities, some in water, some attacking wheat-blossom, or leaves of plants, some feeding at the roots.

The Daddy Longlegs, or Cranefly, likes damp surroundings in every stage of its life, and thus we get an idea of how to keep its numbers in check. The flies frequent damp overshadowed herbage, or marsh-land, or wet, neglected weed-growths, and in such places they lay their eggs.

The grubs thrive in such places, or at the roots of crops so long as the ground is not too dry for them, and when they have fed for some months they turn to a pupa (see Fig. 35, p. 32), which, by means of the spikes at its side, sets itself up in the ground conveniently for the fly to come out from.

* The maggot feeds in decaying Turnip-bulbs.

The best way to forestall attack is to make the land unsuitable for egg-laying. Draining marsh-land, and rough mowing long grass or neglected herbage in shady parts of pasture-fields, hedge-sides, and other like places, drives off a great deal of attack, but the chief difficulty is on land broken up from pasture or clover-ley.

The eggs are mostly laid towards autumn in such localities (that is, pasture-fields or clover-ley); therefore, if these are merely broken up, without any measures having been previously taken to prevent egg-laying, or to kill the "Leather-jacket" grubs in them, it is no wonder that the next crop should often be totally devoured. Any measures that will serve either of these purposes are highly desirable.

Where pastures are to be broken up, it is a good plan to fold sheep on the ground and hand-feed them, thus making the ground obnoxious to the Cranefly for egg-laying, and also, by the trampling and soddening the ground with the droppings of the animals, destroying most of the eggs or young grubs that may chance to be on the surface. Heavy dressings of hot lime are useful, and dressings of fresh gas-lime, or alkali waste, which kill everything they touch whilst in their caustic state, are an excellent preservative from attack. These two chemical dressings cost little (where they are procurable at all), and gradually turn to a manure of the same nature as gypsum.

Salt also has been found useful for dressing leys with in autumn. Laid on at the rate of 10 cwt. the acre, and ploughed in, it has been found to kill the couch-grass (a very serviceable means of prevention of insect-ravage), and there was no further trouble from either grub or wireworm.

Bush-harrowing does good, and paring and burning the surface is also an excellent remedy; but this has drawbacks, on account of the expense of labour, also wasting so much of what, in rotting, would have been fertilizing material.

The most secure method of meeting attack, if we find

it established, is, however, in pushing on a good growth, especially *securing a good start*. This is one reason why deep ploughing is advised in breaking up leys. Some of the eggs and young grubs will thus be turned down too deep to hatch, or to make their way up again. Also, judging by what has been observed in other instances, those eggs which are well turned down out of reach of the amount of air natural to them, will either not hatch or be so much retarded in date of hatching, that the date of attack will also be retarded, and *the young crop has a good chance to get well established before the grubs are ready*. This first start is a very important matter; if the young plant is stunted in its first growth it most likely will never do as well as if it had begun heartily; and this point should be borne in mind as one great method of counteracting injury from insect attacks to roots or leaves.

Get a good start, by using good, fresh seed, by proper treatment of the land beforehand, and, if you can, by burying the enemy so deep down that it will neither make its own way up at the natural time, nor be turned up again by after-ploughing or cultivating, and thus we get our plants so ahead in the race that we may hope to win.

This is a general principle, *suited to all crops*. But to return to special treatment of Daddy Longlegs grubs. If attack is found to be bad in growing corn, some fertilizer, such as guano and salt mixed, applied, say, at the rate of 4 cwt. the acre, has been found to do much good.

Special chemical applications, only intended to kill the grub, have (in the instances noted) been found *not* to do good, because they are so much weakened in passing through the ground that they are quite harmless by the time they reach the creature they were meant to kill. This has been the case with chemical acids,—carbolic acid, for instance,—but whether we might not do good by vegetable applications, such as that of mustard-cake, is a matter for future consideration.

The treatment may shortly be described thus:—prevent egg-laying, if you can; bury eggs and grubs deep down out of the way; give your plant a good start, and keep it well up under attack, if attack comes.

But, further, we should in this, and in all cases, look at the special habit of the pest. The Daddy Longlegs grubs cannot bear heat, light, and drought; therefore two kinds of treatment, apparently quite opposed to each other, have been found useful, for they both bear on the above habits. Hoeing has been found useful, because thus, in dry sunny weather, the powdery, dry ground is just what the "Leather-jacket" grub dislikes. Also rolling at night, or at early dawn, does good; for then, during the cool dusk hours, we may catch many of the grubs on the surface, and they may be crushed by the Cambridge roller or Crosskill's clod-crusher, and rolling the ground firmly in this way likewise prevents some of the grubs "travelling."

There is one more point which has not been brought forward, but which, by watching the habits of the creature, I think might be very usefully worked in garden-ground. I find the grubs like to lie under a thin damp turf; they will collect in large numbers in such a spot. Probably it would answer well in garden-ground to lay slates, turfs, or tiles, and send a boy round every morning to clear what lay below. I have only worked this plan out myself on a small scale, but it is worth considering.

The above is one of our regular yearly attacks, especially to be looked for after a damp autumn and winter, because, as we have seen, dampness and moisture suit the Daddy Longlegs in all their stages.

The next of this gnat-like division of flies we had better consider is the Wheat Midge, the eggs of which produce the little orange or red footless grub known as the "Red Maggot," often found in wheat-ears.

These little gnats are hardly more than an eighth of an inch long in the body, but have long legs and horns, and the female has a long ovipositor, as thin as a hair,

with which she inserts her eggs in the wheat-florets, or those of such other kinds of corn or grass as she may infest.


Fig. 37.—9 and 10, Wheat Midge; 1-6, larvæ, nat. size and magnified; 7 and 8, part of horns, magnified; infested floret.

This operation is mostly performed in the evening, and we are indebted to the observations of Mr. Swanwick, of the Royal Agricultural College Farm, Cirencester, for the information that, just at the time of development, the flies are not only to be found attacking the wheat, but are to be found in great numbers in clover-land which was in wheat in the previous year, and also amongst rough grass at hedge-sides.

The maggots soon hatch, and feed on the germ or some part of the soft grain; they are very little grubs, hardly more than the twelfth of an inch long, yellow, orange, or scarlet in colour, and slightly pointed at the head. The loss they cause by feeding on the corn-grains sometimes amounts to as much as from one to about three sacks (that is, about half the crop) per acre. After they have left off feeding some remain in the corn, and are carried with it, some remain in the stubble, or fall, or go down into the earth, where in time they change to chrysalids, from which the Gnat-flies come out about corn-flowering time in the next year.

In Canada, or where the weather can be reckoned on, and the date of appearance of the Wheat Midge can be reckoned also, injury from attack is avoided by sowing so that the wheat shall flower before or after this special time. In one case the young grain is too firm for the Red Maggot to hurt it; in the other, the flower and germ are not far enough advanced for there to be anything to attack until the Wheat Midge has passed away, consequently the corn is safe. We sometimes benefit in this way here by accidental circumstances, but we cannot depend on being able to arrange it as in less changeable climates.

Our best method of prevention is to destroy the red maggot (or the chrysalis, if it has turned to it) in its winter shelter. Deep ploughing, such as will turn infested stubble thoroughly down, will act well, for once deeply buried the Gnat-fly either will not develop or *cannot* come up again. It is not enough considered in these matters that we may by our own common knowledge often guide ourselves. If a weak small grub (so small that we can scarcely see it) has a weight of earth put on it, somewhere about as much as if at least thirty or forty yards deep of earth were placed on one of ourselves, it is very unlikely that, where it is not specially supplied with powers for piercing the ground, it will come up again as a grub; and the Gnat-fly, if it does develop, certainly cannot make its way through.

This is one of the points that show us how to keep insects in check; we need often merely to consider just what is before our eyes and act on it. Once down, and left down (for, of course, if we bring the grubs up again by a second *equally deep ploughing* we lose our labour), we have in all probability buried the coming attack safely away.

All measures which will lessen the amount of couch-grass, or other wild grass (in which it either is known or believed to lie in the heads or shelter at the roots during winter), would help to keep the amount of this Midge in check. Clearing and burning rough grass by

hedge-sides is one method; gathering up the corn-stubble and burning it, directly the corn is harvested, gets rid of whatever is at the roots; and also (and this is very important) all the dust from the threshing-machine should be burnt where wheat is known to be at all infested. The Red Maggot may often be seen in millions in this, and absence of attack has been found to follow the plan of carefully burning the infested dust.

These are two examples of the class of Gnat-like Flies (*Tipulidæ*, scientifically), which do us much harm. The Daddy Longlegs, of various species, are of the genus *Tipula;* the Wheat Midge of the genus *Cecidomyia*, which includes many other small Gall Gnat Midges, some of which cause galls, and some of which feed, in the grub state, in Willow, and there are also other injurious kinds we cannot enter on now, but which, like the Willow Stem Midge, might be much lessened by noticing where they are in the chrysalis state. In this case to burn worthless, *infested* shoots does much good and costs little; but in all such cases care should be taken to make out where the creature is before going to expense in trying to destroy it, otherwise much cost may be incurred without the slightest use.

There is one other of this family (the *Chironomus plumosus*), of which the grub is known as the "Blood-worm," which deserves a word, not because it does any special harm, but because it gives a hint that where it is, affairs are not as they ought to be. This maggot is like a little bright red worm, and may be seen jerking itself about, or collecting in patches like a clot of blood, in water or on very wet mud, where there is a great deal of putrid matter and decaying leafage, on which the maggots feed. So far they do good, but where they are we find water-snails, such as serve to spread the Liver-fluke of sheep in one of its conditions; also they show the water is very foul. Therefore where the Blood-worm is seen in the water, or the clouds of Gnat Midges (to which they turn) above it, the water needs looking to.

In the histories which we are studying we may seem, perhaps, to be merely considering crop attacks, one after the other, with means of prevention serviceable, if we could remember them; but I wish, before going on, for you to observe that in these histories it is not so much the detail of each I wish you to learn as the principles. You see there are certain habits; certain times when the creature is inactive; certain treatment which will get rid of it equally in the egg, or the chrysalis state, and so on. Therefore though I hope the short histories may be of practical field use further on, yet *now* I want you to look on them chiefly as showing general methods of treatment that we may apply to all similar kinds of attack.

Another very large division of this order of *Diptera* includes what may be known as true Flies,—such as are all more or less like a common House Fly in shape.

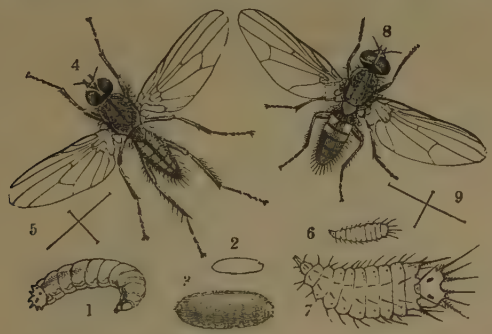


Fig. 38.—Cabbage and Potato Flies: 1-3, maggot and pupa-case of Cabbage Fly; 4 and 5, Root-eating Fly; 6-9, Potato Fly and maggot: all magnified, with nat. size.

They may be known from the Gnats and Gnat-midges by having a short thick proboscis; short horns of only three joints, having a bristle at the tip; and legs and wings of moderate length. The maggots often taper to the head, and are larger, and as it were cut short off, at the tail, which is often furnished with tubercles, and

also with a pair of large spiracles, by means of which the maggot can draw in as much air as it needs by letting the tail project from whatever moist matter it is lying in. The head is a soft mass, furnished with hooks instead of jaws, by means of which the creature can draw, or reap, into itself the soft substances whereon it feeds. The head can be so completely withdrawn into the maggot as not to show externally.

The formation of the pupa-case is a most important matter practically. We know it as the small brown oval case, about an eighth or a quarter of an inch long, which we find by maggot-eaten Onions, or Cabbage-roots, or sometimes in dead animals. It is formed of the hardened skin of the maggot. This draws up, and within it the fly forms, and from it in due time cracks its way out; but meanwhile the coming Fly is wonderfully safe in all circumstances. It is in a little chamber, which protects it from drought and wet and evil influences; and consequently the common crop Flies are not as easily to be got rid of in the pupa or chrysalis state as many other attackers.

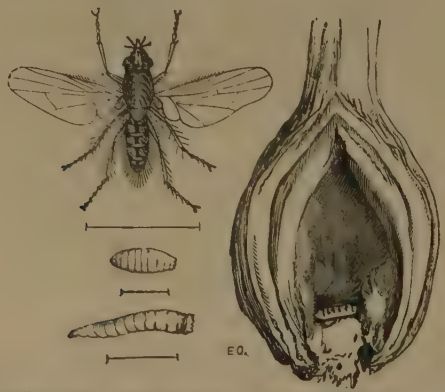

FIG. 39.—Onion Fly, maggot and pupa; magnified. Pupa in stored Onion. Lines showing nat. size.

However much our crop Flies may differ in the part of the plant the maggot feeds on, there are many which

are so much alike in the point of the maggot turning to the above kind of pupa *in the ground* that there are some means of prevention which apply equally well to many kinds of attack.

The Onion maggots feed in the putrefying bulbs, and then usually leave them, and turn to brown oval pupæ in the ground near the destroyed bulb, though sometimes they are stored in it during the winter.

The Cabbage-root maggots also turn to brown oval pupæ in the ground, and so does the maggot of the Carrot Fly. This maggot, when feeding, may be seen with its tail sticking out of the rusty-coloured injured parts, which give this attack the name of *rust;* and in due time we find the brown pupa-cases close by. (See Fig. 42, p. 46.)


Fig. 40.—Turnip leaf-miner, Fly maggot and pupa; nat. size and magnified. Blistered leaf.

The same happens with the maggots of the Celery or Parsnip Fly, and of some of the Turnip leaf-miners, which feed between the two sides of the leaf; and also to a great extent with the Beet Fly (Fig. 41). The pupæ of these are respectively, either entirely or to some extent, to be found in the ground near the attacked plant; and this is one reason of the great use of rotation of crops as a means of prevention.

Where there has been an infested crop in autumn there will be many of the pupa-cases in the earth; when

spring comes the Flies crack their way out of their husks, and then are all ready to lay their eggs on their own food crop if it is on the same place, or near. This is an important point in field Cabbage growing, where

Fig. 41.—Beet Fly and pupa, mag. and nat. size; head and eggs, mag.

Cabbage crops are often repeated time after time, and also in Onion and Carrot growing. We may bury many of the pupa-cases just as we can bury Daddy Longlegs or Wheat-midge grubs, but we must be even more careful not to bring them up again before the time for the Fly hatching out of them has passed, for the cases are firm and strong, and the Fly within them so well protected it will bear a deal of burying and moving about without any damage.

The Onion, Cabbage, Beet, and Celery Fly, and some others, have several broods in the summer. This is the reason why it is an object to check the very first attack, even by destroying part of the crop. Often by raising the attacked Onions with a spud or a broad knife, or something that will quite *certainly* bring up all the maggots, we can check the attack, and destroy the parents of what would in a few weeks have been a devastating horde. Or it is a better plan still to pour a few drops of carbolic acid carefully on the destroyed bulb. This kills every grub it touches, and does not encourage further attack by loosening the soil, or bruising good bulbs. We may sometimes check Celery or Beet and Mangold Fly attack by cutting off bits of leaf, or drawing plants which are infested. But we should be sure to destroy the drawn plants. If they

are merely left on the field, or thrown to the rubbish-heap, the maggots which are full grown will turn to pupæ, and the Flies develop as well as if nothing had been done.

In all cases of maggot attack to roots or bulbs, it should be borne in mind that if we can keep the Flies from laying their eggs *on or very near* what is their maggot food that the plants will be to a great extent safe. One at least of the Onion Flies lays her eggs on the bulb, apparently on the lowest part she can reach. If Onions are knocked about and left bare in hoeing they are at the mercy of the Fly, which in this and other cases appears attracted by the smell of the injured crop.

With Onions, and also with Carrots, attack very often follows on thinning; but the matter may be met. I have found that in garden treatment, where Onions were in rows, that earthing them well up above the collars answered well; and with Carrots it has been found, by various good growers, that thinning so early that the operation did not throw the ground open was a successful treatment, particularly if followed by copious waterings to "settle" the ground.

These are points of general application,—a sort of physical-force treatment. Bury the enemy beforehand if you can; but if you have it in the ground where it can do harm then (as far as you can) keep your crop grubs, and your coming crops at a distance; and in cases where the Flies require to lay their eggs on a bulb, or to go down cracks to get at the roots, then think over the matter well as to whether some such way as I have suggested (or sôme much better way, which you may think of for yourselves) cannot be managed so as to defend the plant,—to lock the door, as it were, in face of the thief. The Fly has got to lay her eggs, and then she will die; and if we can protect our plants so that (as I have seen with Onion Fly) they had to be dropped at hap-hazard, where they would come to nothing, it saves much coming trouble.

# LECTURE IV.

## FLIES (CONTINUED) AND FLEAS.

### (*DIPTERA* AND *APHANIPTERA*.)

### HAULM FLY, CATTLE FLIES, FLEA, &c.

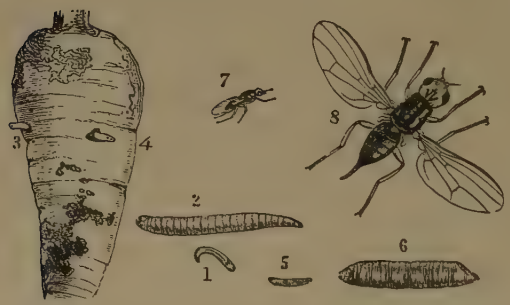


FIG. 42.—Carrot Fly: 1 and 2, maggot; 5 and 6, pupa. All nat. size and magnified. Infested Carrot.

BEFORE going on with our observations on Crop Flies, I wish you to notice that I am not giving a special description of the appearance of the insect that causes each kind of attack: firstly, because mere word descriptions given thus, one after the other, would be only confusing; next, because description does not seem needed.

The figures of the insects in their various stages convey what they are like far better than words; and, for practical purposes in the fields, if we see footless maggots, pointed at one end and cut short at the other, feeding amongst the roots or within the leaves of any common crop, we may tell pretty surely that they are Fly maggots, and by looking out that crop in the index of whatever book we may choose for our guide may learn the history of the insect, if it is (as is likely) one of the common attackers.

We have seen that many of these Crop Flies are alike in the habit of going through all their changes—egg, maggot, pupa, and fly—quickly in summer (so that there may be two, three, or four generations), and that the pupæ of the last autumn brood often lie (if we will allow them) safely, and uninjured by cold or common amount of moisture during winter, so long as they are in their own natural shelters; and in the case of these insects we know where they are *all the year round.*

Now before going on to the methods of preparation of the ground, or manures destructive or attractive to Flies or Maggots, it will be well to look at what has been a very puzzling point. There are some kinds of Fly which go through all their changes and come out as perfect insects in autumn, and then we see no more of them until about the middle of the following summer. But the question arises, What are the Flies doing during all this time? We have an answer to this, in one case, in the habits which have been noticed of one of the Corn Flies, which are useful to know in themselves, and as giving a clue where or *how* to look for other enemies.

The small striped Yellow Haulm Fly, or Ribbon-footed Corn Fly (*Chlorops tæniopus*), lays its eggs on the growing Barley stem, at or near the base of the ear, and the maggot eats a furrow down the stem to the first knot. Consequently the growth becomes diseased or stunted, the ear often does not develop, and remains in its sheath, and within the sheath the maggot turns to a reddish brown pupa; and when the Barley has been stacked the little Flies sometimes are to be found by handfuls in the stacks. Now comes the winter history, which is very different. These autumn Flies have been found to lay their eggs on autumn-sown corn, *or on wild grass;* the maggot when hatched pierces into the heart of the young plant, and there it passes the winter. When spring comes it is stated that the unattacked parts grow as usual, but the attacked portion only produces a diseased growth of broad leaves and thickened shoot, which commonly perishes. The maggot

turns to the pupa within, and from this there comes out the Haulm Fly, somewhere in March or April, in due season to lay its eggs and begin the summer attack.


Fig. 43.—Haulm Fly, grub and pupa; nat. size and magnified; with infested stem. 7, 8, 9 and 10, Parasite Flies; nat. size and magnified.

This fact has long been known, but has never, as far as I know, been turned to the use it might be in England. But, any way, we learn from this that maggots can live as maggots within their food-plants during the winter, and also that the same kind of maggots can form different kinds of diseased plant-growth, according to the season or the condition of the plant it attacks. This is an important point to know, for there are other insect attacks of which we only know what we may call the summer half; we need the winter history, too, to be able to check attack, and this one history gives an example of a winter state not at all in accordance with the fanciful theories sometimes started, but the plain straightforward fact that the autumn Fly lays its eggs in the food-plant in its autumn state, and the maggot

lives on there. In this case spring-sown Wheat is manifestly safe from attack during its early growth; and clearing away the masses of wild grass, which often are allowed to grow in strips several feet wide by hedges, would get rid of winter-quarters of the Fly, which often may be found especially infesting the corn by these grass headlands. It is often also found to infest patches, or an acre or more of wet land in a field, where the rest of the crop is free; and here we get to the point of the state of the land, or the effect of special manure on amount of Fly attack.

A very large number of Fly maggots prefer moist localities. We see that they are specially fitted for living in such places by the spiracles, or some form of breathing-pores or tubes, at or near the end of their tails, which allow them to lie safely in wet matter, so long as the tip of the tail is exposed to the air. The Gnat grubs live in water, the Daddy Long-legs grubs live by preference in damp places, and may be totally immersed for many hours without being drowned. The maggots of some of the Breeze Flies, or *Tabanidæ* (the great Ox Gad Fly, for instance), live in damp ground, or under putrefying vegetable matter in damp places. A vast number of maggots live in dung and rotting animal remains, which they do us much good by removing; and in the family of the *Œstridæ*, or Bot Flies, the maggots live sometimes in abscesses outside, sometimes in purulent humours within, the animal attacked. These maggots have an apparatus at the tip of the tail, which contains the chief breathing organs.

Looking at some of the common crop maggots, we find that they not only live on various kinds of plant roots, but also in dung; and the question therefore comes whether the use of animal manure in a state, and at the time, when it may bring maggots with it to the coming crop, is desirable. We need plenty of good strong manure if the crops are to grow, but still there are different ways of treating it before application, and different times of applying it.

It has been found that the "Root-eating" Flies, the *Anthomyia radicum* (Fig. 38, 4), of which the maggots feed on Cabbage and Turnip roots, inhabit dung by thousands, and especially frequent night-soil; also that they attacked crops manured with horse-dung and bone-dust, whilst on ground close by plants manured with superphosphate were not at all attacked.

Another kind of Cabbage-root maggot, that of the *A. floralis*, was found by myself in earth round partly decayed Clover-roots.

The spiny maggots of the *Anthomyia tuberosa*, the Potato Fly, as it was named by John Curtis (figured with the perfect Fly, at p. 41), have been found swarming in rotten Potatoes, and also, as well as their chrysalids, in ground often occupied by Cabbage.

The maggots of the Shallot Fly (*A. platura*) have been found in great numbers in night-soil; and I have a note of attack of Onion maggot having showed itself in the greatest numbers where cow manure had laid for a considerable time before being dug in. All the plants, where or near to where the heaps had been, were destroyed by the 1st of July.

Our great authority on Flies, Dr. Rudolph Schiner, says of the division of *Anthomyia*, to which the Beet Flies, Onion Flies, and Cabbage Flies belong, that in many cases the larvæ live in vegetable substances, and also that many seek out rotting and putrefying matter; and of the very nearly-allied family of *Hylemyia*, which includes our Wheat-bulb Fly (to give a single example), he says such of the maggots as are known are found in decaying vegetable matter, cow-dung, &c.

From these notes it would appear that whether we start Fly attack or not by much use of animal manure, that at least where infested Cabbage has grown, we are not likely to get rid of the grub from the ground by simply digging in stable or cow-shed manure; on the other hand, we find chemical dressings have cleared it. We have instances of grub attack not having taken place in an infested district, or having been cleared out where it

existed, by the use of gas-lime, or hot lime. The gas-lime was carted on to the land during frost, and presently spread; and the land on which this was sprinkled escaped attack, whilst on that which was not dressed the crop was lost by maggot. Where the crop has been cleared by maggot, it has been found that a handful of hot lime mixed with the soil, before dibbling in the new plants, prevented any new attack. Superphosphate of lime is also recommended in continental practice.

How these different forms of lime act I do not know, but it seems to me it must be in several ways at once. The Fly needs a damp material to lay her eggs in, with some instinctive prospect of food for the maggots, and the lime does not present her with either one or the other: the maggots have a poisonous material instead of food added to the soil, and altogether the position is made quite an unnatural one for the attack.

Where a plentiful supply of farm manure is used, we find (with various crops subject to Fly attack) that it answers well to prepare the ground and put the manure in during the previous winter. With Onions it has been found the most successful plan of growing is to work the soil deeply in the autumn or winter, and put a good layer of manure at the bottom of the trench, or work it well into the soil. The surface is laid up rough or ridged for the winter, and when sowing time draws near is levelled. Thus there is no fresh farm manure on the surface, although some fertiliser, such as soot or wood-ashes, lime, &c., is usually strewn on the surface, or otherwise applied, at sowing time. With Carrots it has also been found to answer best thus to prepare the ground beforehand.

In this way we join many points that are wanted. It is very difficult to say in Insect prevention, use this or that treatment, but we should bear in mind that there are certain points we want to bring about, and the chief one of these is to keep the *crop safe*. For this many arrangements must go on together: we need a fertile soil, but at the same time we need that the fertility should be

of a kind that will not feed the insect as much as the plant, therefore chemical dressings on the surface are useful.

There are at least between two and three thousand species of British Flies, and it is impossible for anyone who does not give special attention to the subject to know them surely one from the other. But still there is something may be done by taking them in large divisions according to their habits, as well as their appearance.

We have glanced at the habits of the Gnat-like Flies in their attacks to Corn and pastures, &c., and to what we may describe as food-crop and manure-feeding Flies. There is still, classing them by their habits, a third division, which is very important,—that of the Gad Flies and Bot Flies, which cause much injury to cattle, sheep, and other farm animals.

The Gad Flies (*Tabanidæ*) include some of the largest Flies which we have in this country, and cause injury by piercing into the skin—may be of cattle and horses, may be of ourselves—with the lancet-like apparatus which they carry in their proboscis. In shape they may be described as like common Flies; but the great dark brown Fly striped across with yellow, known as Ox Gad Fly, is sometimes as much as an inch and three quarters in the spread of the wings.

I have had no opportunity for observing the habits of cattle Flies, and therefore give a few quotations, regarding the habits of the maggots, from the 'Fauna Austriaca' of Dr. Rudolph Schiner, one of our most recent as well as greatest authorities on the Diptera. He says of the genus *Tabanus*:—"The larvæ live in moist earth, or in sand, or under decaying leaves and stems in damp places. The Flies are often found in cattle pastures, and by roads and paths, where they rest on neighbouring trees, and lie in wait for horses and cattle, to which the blood-sucking females are very troublesome. The males also frequent flowers, or hover, especially in the morning and evening, by roads, in the sunshine."*

* 'Fauna Austriaca, Diptera,' vol. i., p. 29. (The grubs or maggots are to be found in grass-land, especially where it is wooded, from September until May.)

The only way of saving the cattle from attack would appear to be, moving them from pastures by streams, or such localities as the Flies frequent, to more open and dryer land, where the state of the ground would not suit the Gad Fly maggots, and the Flies would not find the trees which they love to lurk amongst.

These "Gad Flies," or *Tabanidæ*, of which there are many kinds, are injurious as *blood-suckers*. The other large family of cattle Flies, commonly known as "Bot Flies," differ from them entirely in their method of doing harm, inasmuch as, generally speaking, *the mouth is obsolete*, only represented by a few minute fleshy tubercles.

The maggots of this family of Flies live within some part of the animal that is attacked; and Prof. Westwood notes three principal differences in their habits:—Some live in tumours beneath the skin; some attack the cavities of the head, which are reached through the nostrils; and some are gastric in their attack, by the maggots being introduced into the stomach.

These Flies belong to the family of the *Œstridæ;* and the kinds we are about to notice are nearly the size of a house Fly, or rather larger, and are sometimes gaily coloured, and sometimes very hairy.

In the case of the Horse Bot Fly (*Œstrus* [*gasterophilus*] *Equi*), the female hardly touches the animal, but whilst lightly flying to and fro places the eggs on the hairs, until the very numerous supply are laid. These are fixed by a kind of sticky moisture on the shoulder, inside the knee, or on any other part selected. The maggot forms within the egg, and when it is ready to hatch (which is stated to be after about five days) the warmth and moisture of the horse's tongue in licking the infested hair causes the kind of lid or cap to open or crack, and the maggot within sticks to the tongue, and is thus gradually transferred to the stomach. Here the maggots establish themselves, and maintain their hold by means of two hooks, which are placed below the small jaws, and also by means of the spines or

bristles with which they are furnished, and which help them in progress through the intestines afterwards. Here they live until, when full-fed, they loose their hold; and, after being thrown to the ground, turn to a brown pupa, from which the Fly comes out in a few weeks.

The remedy advised is watching the condition of the coat of the animal, and brushing away the eggs; and also, as with plants, keeping the attacked subject in such good health that the internal irritation may not be of serious consequence.

The Ox Bot Fly (*Œstrus bovis*), a large and handsome white-gray and yellow hairy Fly, lays her eggs on the back of cattle,—whether they are fastened to the hair or inserted under the skin does not appear, as yet, to be quite settled; but here the maggots hatch, and, by the irritation of their presence, cause a swelling, or ulcerated tumour, within which the maggots feed. But in this case the maggots are *not* furnished with jaw-hooks; they have merely soft fleshy mouth-parts, with which they can draw in the matter in which they lie; and, further, that they may have all needful amount of air, they are furnished with two large spiracles, or breathing-pores, at the end of the tail, which is protruded from the tumour wherein the creatures live. When full-grown these maggots are stated to be about an inch long; then they leave the tumours, and, after falling to the ground, draw themselves under some shelter, or bury themselves in the earth. There they turn to a blackish pupa, which is said somewhat to resemble the half of a walnut-shell in shape, being flat on one side and rounded on the other; and from this the Fly hatches in a few weeks.

Without entering on veterinary details as to the treatment of attacked animals, it is worth notice for preventive arrangements that in many respects this Bot Fly (the *Œstrus bovis*) is just the opposite in the places it frequents to the Ox Gad Fly (the *Tabanus bovinus*). It is mentioned as frequenting the neighbourhood of woods rather than meadows, but also it seems "to avoid water and damp

localities." Another authority says the Fly "never ventures over water," and consequently a pool in the pastures is a great safeguard, and one naturally resorted to by the cattle.

The attack of the Sheep Bot Fly (the *Œstrus* [*Cephalemyia*] *Ovis*) is a very serious matter, which causes much suffering to the animals, and loss to their owners. This Fly is rather larger than the common house Fly, and of an ashy colour, spotted with black. The female either lays her eggs or deposits living maggots on the margins of the nostrils of the sheep, from whence the maggots crawl up the nostrils by means of the mouth-hooks with which they are furnished, and attach themselves to the membranes of the cavities. Here they feed on the mucus; and it is stated that they at times feed on the membrane itself, and also at times penetrate into the brain. Their presence causes great irritation; and where the attack is severe leads to gradual loss of strength, and convulsions (and other symptoms by which the cause of the illness is distinguishable, which we need not enter on now), and the death of the animal. In the common course of things the maggots remain in the head of the sheep for about eight to ten months before they are mature. They then leave the animal by going down the nostrils, and fall to the ground, where they turn—either amongst roots of grass, or in any convenient place above or below the surface—to a black pupa, from which the Fly comes out after a variable number of days, according to the climate.

The preventive in this case is to keep the Fly from getting access to the nose of the sheep. The sheep protect themselves to the best of their power by holding their nostrils down to the ground, or in any other position which will keep off the Fly, when they are aware of attack; and this principle is worked on, in the application of tar or other remedies to keep the Fly from settling.

Other remedies are applied for these and the various attacks of cattle Flies, of which I have just mentioned

the main points of a few, on account of their great importance; but as they belong rather to the veterinary branch of agriculture rather than to my own department, I have not been able to offer personal observations.*

But here, as elsewhere, something on a broad scale of prevention may be done,—firstly, by noticing the localities the different kind of Flies frequent, and acting on this by removal of cattle; or other means, such as affording access to pools, or dry ground, &c., as circumstances may point out. But further, it would appear that as the maggots of all the kinds we have noticed turn to pupæ in the ground or grass of the pastures where the attacked animals feed, that it might be desirable to break up infested land more frequently.

There is another small division of Flies which infest horses, sheep and other animals, also birds, which are remarkable for going through their first stages in the abdomen of the female, and being produced as pupæ; whence this division is known as *pupipara*. The head of these flies is so withdrawn into the body, and the horns into the head, that, in addition to their sometimes being without wings or poisers, they have a spider-like appearance, and some are known as Spider Flies. The "Sheep-tick," which lives in the wool and sucks the blood of the sheep, is one of the *pupipara*.

Fig. 44.—Sheep-tick, magnified.

The short time that remains to us this morning may be given to a few words on an order very limited in its extent, but of which one kind is much too well known to us all. Though it is injurious to ourselves rather than to our crops, it may be noticed, as it is most to be met with in the dust and dirt, and other matters, often found in sheds and outhouses, and slaughter-houses, round neglected farmyards. I allude to the order of Fleas.

* I have mainly availed myself of observations by Prof. Westwood, Mr. Bracy Clark, Prof. Riley, and Dr. R. Schiner.

The general appearance of our common Flea is well known; but if you will examine it under a magnifying-glass you will see there some peculiar points in its structure. The insect is not divided like most others, but formed of a continuous series of rings from the head to the tip of the tail. It is to all practical purposes wingless, but at the base of the 2nd and 3rd segments from the head there is on each side a small scale. These two pairs of scales are considered to represent the two pairs of wings that most insects possess, but as they are hardly perceptible the order has from them been named *Aphaniptera* ("imperceptible-winged"). The legs look as if they had two extra joints above the thigh. The one that joins to the thigh is a much enlarged form of the hip-joint, or *coxa*, which hardly shows in the legs of many insects, and therefore is a good anatomical example; and above it, joining the coxa, or hip, to the body, is a prolonged growth from the lower part of it, giving the appearance of the leg being formed of five joints.

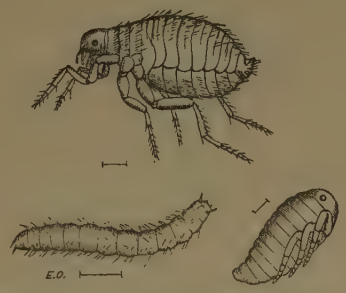


FIG. 45.—Flea: maggot and pupa, mag.

Fleas lay about ten or twenty eggs in hair of animals, or dusty nooks or crannies, &c., especially where infested animals lie. From these eggs, white, worm-like, footless grubs hatch, which feed on animal matter, and notably on blood. In summer they change their condition in about a fortnight, and, after casting their skin, appear as chrysalids, resembling the perfect Flea, but inactive, and with the legs folded beneath it. From these the Fleas are said to appear in rather more or less than fourteen days.

From personal experience I can say that these most unpleasant creatures sometimes swarm in legions in

neglected yards, where they may be seen by scores skipping in all directions about the haunts where nothing but dirt and neglect has allowed them to be reared, although their presence will very likely be stated to be "quite unaccountable." Order and cleanliness, proper clearing out of old skins and rubbish, scalding out dog-kennels and slaughter-houses, and all other head-quarters of filth, and letting brooms, scrapers, and whitewash do their work in poultry-sheds, and all other places, will promptly reduce the armies.

We close our morning's work with an unpleasant subject, but one that calls for attention, as being, like many other insect attacks, not only a cause of annoyance, but a clear sign of neglect somewhere or other.

To-morrow we may devote to examining into the habits of Beetles, and means of preventing their ravages.

# LECTURE V.

## BEETLES (*COLEOPTERA*).

### Cockchafers, Click Beetles, &c.

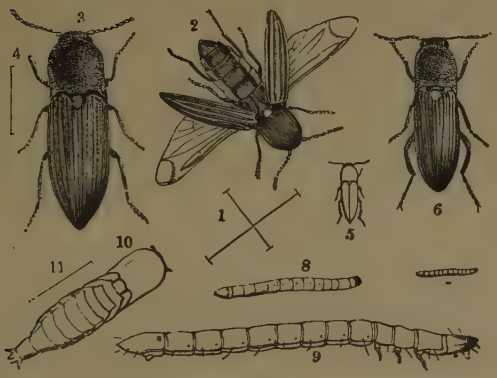


Fig. 46.—Click Beetles and Wireworms: 1 and 2, *Elater lineatus;* 3 and 4, *E. obscurus;* 5 and 6, *E. sputator*, nat. size and magnified; 7, Wireworm of *E. sputator?* 8 and 9, Wireworm of *E. lineatus*, nat. size and magnified; 10, back of pupa of Wireworm. Lines show nat. length.

We now pass on to the order of Beetles, *Coleoptera*. From the fact of there being a very large number of different kinds, and also from a great number of these injuring the crop, both in the grub and in the Beetle state, this order is, perhaps, the most important of all to the farmer.

You will notice that, so far as we have advanced, there is just, so to say, a step onwards in the number of legs and wings in each order. Flies have usually one pair of wings, and their maggots are usually legless. Fleas have also legless maggots, but the position of two pairs of wings are marked by scales; and now in the Beetles we find that the maggots or grubs are sometimes legless, but also sometimes have three pairs of jointed legs,—one pair on each of the three segments nearest

the head, and also a sucker-foot beneath the tail, which serves to help in moving, or to hold fast with when pulled at.

The perfect Beetles,* such as the Cockchafer, or Lady-bird, or Turnip Flea Beetle, have two pairs of wings. The upper pair, or wing-cases, which are known as the *elytra*, are hard and horny, and form a cover or "sheath" for the lower pair; and from this the order of Beetles takes its name of *Coleoptera*, or sheath-winged. The under wings are membranous and large when spread out in flight; when at rest they are folded both *lengthwise and across*, so as to fit under the wing-cases. The jaws are horizontal, somewhat like toothed-pincers laid flat, so as to work against each other from side to side.

The Beetle chrysalis is much like the perfect Beetle in shape, but without power of moving about. It lies with the forming limbs, and mouth parts, beneath it, usually all cased in separate sheaths, like a thin outer skin, until it is matured, when it gradually frees its limbs, and gains the full colour and powers.

Though there are such great numbers of different kinds of Beetles, the distinctions between the chief divisions are fairly easy to observe; and I will just point out a very few of these that may be of service before going on to the practical observations.

Beetles are, firstly, divided into four sets, according to the number of joints in their feet.

One *division* has all the feet usually *five-jointed*. This includes six *sections*, of which those of the carnivorous Beetles, the Cockchafers and their allies, and the Click Beetles (or Wireworm Beetles) and their allies, concern us the most. This division is named *Pentamera*.

The *second division* has, for the most part, the *feet of the two front pairs of legs five-jointed, and the feet of the hind pair four-jointed*. This division has only one *section*, in which various grain and meal Beetles concern us most. This division is named *Heteromera*.

* For illustrations, see figures of Beetles in this and the following Lecture.

The *third division* has all the feet *apparently four-jointed*, because the fourth of the five joints is so small it can hardly be seen without a magnifier. This division, *Tetramera*, includes three *sections*, all very important to us. They are the Weevils; the Long-horned Beetles, which are often destructive to timber; and the Turnip Flea Beetles and their allies. The illustration shows the leg of one of the Flea Beetles with its four-jointed foot.


FIG. 47.—Hop Flea Beetle, and four-jointed foot.

The *fourth division* has all the feet *apparently* three-jointed, because the third of the four joints is so small it is scarcely visible. This division, *Trimera*, includes one *section*, and in it the family of Ladybirds and their allies is most important to us.

These divisions by number of joints may seem tedious, or trivial points to observe; nevertheless it is very convenient, when one wishes to know something of the nature of a Beetle, to be able merely by a glance through a hand-magnifier at its feet to know generally to which division it belongs. In the hundreds, or rather thousands, of British Beetles there are many so very like in appearance, yet different in habits, that sometimes it saves much trouble thus by a little examination to know whether what we have caught is a destroyer of crop pests in the field, or of our corn in our granaries.

The Ground Beetles, which belong to the *first section* of the Beetles, have been until lately thought to be almost entirely carnivorous. It is hardly possible to convey an idea of the appearance of these different insects merely by description, but the two figures (p. 62) give an idea of their shape.

These *Geodephaga* may be known in a general way by their long slender legs, and horns, their strong jaws, and their great activity in running.

The grubs of these "Ground Beetles" are flat, long, and straight-sided; the head, and next segment to it, hard (see figure, p. 15). They have, for the most part, strong jaws, three pairs of horny legs; and at the tip of the tail there is usually a sucker-foot below, and two horny or fleshy appendages above.

For a long time these "Ground Beetles" were supposed to live almost entirely on animal food, and therefore to help very much in keeping other insects in check; but now it is found that various kinds injure growing grain, seeds of grass, and other vegetables.


Fig. 48.—Ground Beetles: 1, *Carabus granulatus;* 2, *C. nitens.*

In the United States it has been found, by watching the habits and examining the contents of different kinds of *Harpalus*, that these feed on rootlets, seeds, and other parts of grass or corn, besides other matters animal and vegetable. In Prof. Forbes experiments it was found that of twenty-eight specimens of *Carabidæ* examined, twenty specimens, and these belonging to eleven species, had eaten vegetable food.

This has not been worked out fully in England. Curtis drew attention to the subject many years ago, and pointed out the *Zabrus gibbus* figured (p. 15) was very injurious as a kind of Ground Beetle which injured the Wheat; also he expressed doubts whether *Harpalus* grubs did not injure Wheat also in the same

way as Wireworm. Further, in the course of 1882, observations were sent which incline me to think the *Harpalus ruficornis* sometimes attacks strawberries in large numbers.

These observations make it very desirable to keep an eye to the habits of the many kinds of these pitchy or brownish "Ground" Beetles that we see so active in summer in cornfields, and which have generally been supposed to be employed in clearing off insect vermin.

Fig. 49.—Water Beetle

The water kinds (*Hydradephaga*) can swim as well as fly. Their somewhat flattened oval shape, and their hinder legs, being for the most part broad, with a long fringe of hairs on the inside, give them the power of rowing quickly through the water; and the large wings folded under the cases give them the power of going to and from it as they wish.

The *second section*, commonly called Rove Beetles, or Devil's Coach-horses, may be generally known by the

Fig. 50.—Sculptured Rove Beetle and grub; nat. size and mag.

short wing-cases, and their habit of arching up their tails when annoyed. Some feed on animal matter, including other living insects, and they much frequent

rotten animal and vegetable matter. The grubs are very like those just described, but may be known by the


Fig. 51.—Earwig Rove Beetle and head; head magnified.

fork above the tail being double-jointed, and furnished with stiff hairs. Both grubs and insects help us in clearing off other insect presence.

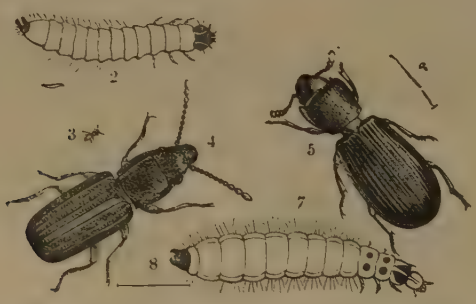


Fig. 52.—Corn *Cucujus* and *Cadelle*: 2-4, *Cucujus testaceus*; 5-8, *Trogosita mauritanica*; magnified, with nat. size.

The *third section* is that of the Carrion, or Burying, or Sexton Beetles. These are very various in their habits. The grubs of the *Cadelle* and Corn *Cucujus* figured, feed on stored Corn; but this section appears to live for the most part in dead animals, carrion, and

what we may shortly describe as "filth" generally. Their horns are usually enlarged or club-shaped towards the tip, or bent as if they had an elbow; and the wing-cases usually bend down at the sides, so as to cover the sides of the abdomen.

Fig. 53.—Sexton Beetle, magnified.

A few of these, like the little Turnip-blossom Beetle, the *Meligethes*, feed in flowers, and the only known way of getting rid of these, when present, appears to be the continental plan of sending people through the fields early in the morning, or on a damp cloudy day when the Beetle will not fly, and, by smartly striking the plants, shaking the Beetles into bags held below. The plan is found to pay, for the worker can go over the ground rapidly.

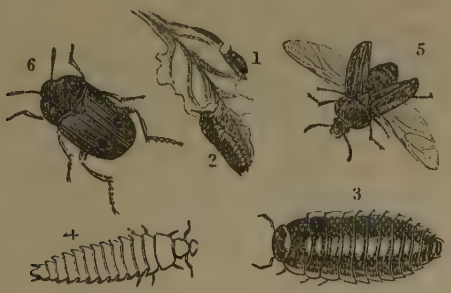


Fig. 54.—Beet-Carrion Beetle: 5 and 6, Beetles; 1-4, larva, nat. size and magnified.

In the Beet-Carrion Beetle, which takes its double name from its double habit of feeding, we have again an example of the mischief which is, or may be, often caused to a crop by bringing out manure in which there is a two-fold kind of feeder.

The egg of this Beetle is commonly laid in putrid matter, such as dead birds, hedgehogs, or the like, but sometimes the grubs attack Beet or Mangold Wurzel

leaves in such great numbers as to clear off all but the fibres, and thus ruin the crop. In the cases noted it appears likely that offal or carrion may have been mixed with the manure, and thus attracted the Beetle, and the eggs or grubs were carried out in the rotting substances. Though the attack is not common, when it occurs it is bad, and, unless care is taken, is apt to recur for some years, though probably proper treatment of the manure would prevent recurrence. As this attack only lasts for a few weeks (the grubs are full-fed about the end of June), the crop may often be saved by timely dressings of superphosphate, or some good fertilizer. The figure shows the Beetle and two slightly different shapes of grub.

These three *sections*, that is, the divisions of Ground Beetles, Coach-horse Rove Beetles, and Carrion, or Sexton Beetles, are fairly well marked both in appearance and habits. Only a few of them, as far as we know, hurt the crops; but (in order that we may not waste labour in clearing away what is doing good rather than harm), it is well to remember just this much about them:—The Ground Beetles feed chiefly on live prey, this being their insect-brethren or otherwise, as may chance: the Coach-horse Beetles sometimes feed on live animal food, but chiefly on putrid matter: the Carrion or Sexton Beetles feed in many kinds of matter, often in dead birds or any dead animals, also in putrid fish, fungi, &c., and in animal droppings. Some, however, like the Beet-Carrion Beetle, do harm occasionally by their grubs feeding on plant-leaves, and some of the small beetles feed in flowers, thereby spoiling the seed crop. The beetles of this division, which live in water and mud, do not need comment.

The fourth *section* is the very important one of the Chafers and their allies. Some do us little harm, like the Stag Beetles, of which the grubs, as far as I know, live in rotten wood; or again, the Clock or Dor Beetles (*Geotrupidæ*), which bore down into the ground, especially where droppings are lying, in cattle pastures,

and carry the dung into the soil as food for their grubs. But there are many kinds, such as the Small May-bug


Fig. 55.—Field or Garden Chafers: 1 and 2, *Anisoplia agricola*; 3, *A. horticola*, nat. size; 4 and 5, the same, and grub, mag.

or Garden Chafer (*Anisoplia horticola*), 3, 4, 5, Fig. 55, (of which the grub does much harm in pasture land), together with another much rarer kind, the *A. agricola*; also the Common Cockchafer, the Great Golden Chafer,

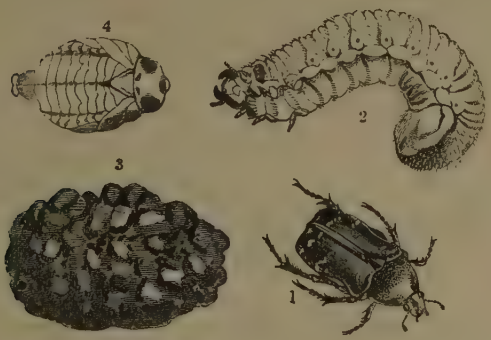


Fig. 56.—Golden Chafer: beetle, grub, back of pupa, and earth cocoon.

and others which feed in the beetle-state on leaves of trees, or within flowers, and as grubs on the roots of grass, corn, or other ground crops, as well as trees here;

and in the colonies on the roots of Coffee and Sugar-cane, and altogether cause most serious loss.

The Beetles are generally to be known by having a club of several leaves on their horns, such as the fan-like end that we see to the horn of the Cockchafer; and the grubs are large (sometimes as thick as the finger) and fleshy, with the end of the tail curved downwards and enlarged, as if it was swollen, so that the grub usually lies on its side. By this swollen tail and arched shape, and also by having three pairs of longish legs and strong jaws, you may commonly know the Chafer grubs. (See Fig. 5, p. 6.)

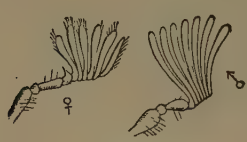


Fig. 57.—Club of male, with seven leaves; club of female, with six leaves, magnified.

The habits of different kinds of Chafers vary in such matters as the depth to which the grubs bury themselves, or at which they turn to chrysalids, the length of time they pass in these two states, and also the time of day or evening when the Beetles are at rest, which is a very important point in regard to getting rid of them; but the life-history of the common Cockchafer gives a good general idea of that of the kinds that we are most troubled by.

The Beetles appear in early summer, and feed on leafage of many kinds of trees. The females lay their eggs in ground which is either cracked or will allow of the female burrowing down into it to lay (the state and kind of ground is an important matter); she lays from twelve to as many as thirty eggs from about four to eight inches deep. The grubs from these hatch in a few weeks, and feed on roots; may be devastating young Fir plantations, or attacking Flax or Carrots, or many other crops, or ruining grass fields; there is a surprising variety in the kind of crop infested. After feeding for three or four years they go as much as two feet or more down into the ground to turn to chrysalids, from which the Beetles come up in the following summer, that is,

the fourth (or, according to other opinions, the fifth) summer after they were hatched.

Many of the Chafers only fly at some special time in the day, and rest during the other hours in the leafage of trees. The only way that appears known to get rid of the beetles is to profit by this habit. Find what trees they frequent, and at what time they are resting, and then beat them down. They may be beaten down on cloths, and gathered up in any convenient way and destroyed; but it is a simpler plan to have a drove of pigs in waiting, which will destroy the Chafers before they can be ready to fly away. This plan of beating is found to answer both in European and colonial practice, as it stops present damage to the leafage, and coming increase from eggs that would be laid.

The great point is to keep the female from *going down* into the ground to lay her eggs. Sometimes, where the soil is of soft vegetable remains (as amongst the Coffee plantations in Ceylon), it is found that laying a coat of the clay subsoil on the top answers, and, for field treatment, it has been advised to lay a good covering of some harder material, as marl, or road-scrapings on the surface, or to give a top-dressing of salt or gas-lime, or some application which might make the surface unsuitable for laying. Probably gas-lime would be very serviceable, and the washings down from this would be likely to drive any grubs near the surface away,—for a time at least,—and thus give the crop a respite. Gas-water applied at a strength which would not hurt the grass has been found to act well; the strength, of course, must be found by trial, as this varies much.

The attack of the grubs to roots of *growing* crops, whether in the field or of plantation trees, is very difficult to meet. In plantations the only sure way appears to be the plan practised in Ceylon, of setting people to dig up the grubs with stout wooden pegs, or any other convenient implement. In this case the ground *should not be disturbed before the worker*, but just sprinkled with lime. The operator then goes regularly forward, clearing

to the depth at which the grubs lie, and stirring the lime into the soil; and the plan is found to answer both in benefit to the trees and in getting rid of the grub.

With such kinds as the Sugar-cane Chafer (*Pentodon fossator*) of Trinidad, which turn to chrysalids just below the surface of the ground, the plan of turning them out of their earth-cells by any common agricultural measure answers perfectly at small cost, and where grubs are in unoccupied ground, that is, after the grass or crop has been killed or gathered, a great many may be got rid of by ploughing or digging deep enough to turn them up, and calling in the help of children to collect and destroy them, or that of the pigs, which will do much work without pay. The wild birds also, such as sea-gulls and rooks, should on no account be driven away.

There is, however, another treatment not nearly enough thought of which is applicable to all cases of infested land free of crop, and that is putting on a heavy killing dressing. Caustic gas-lime may thus be used, and alkali waste is excellent for the purpose. These are very much alike in their nature and effects; at first they destroy everything they touch, whether plant or insect, and the alkali waste is also used to clean the ground of deep-rooted weeds, such as Couch-grass, Coltsfoot, and Thistles, and is washed down by rain into the soil so as to make the drains run milky at a depth of three feet. This is procurable for little if any outlay beyond cost of carriage from chemical works, where it is thrown out as waste. Now attention has been drawn to its value, and it is likely to be made available. When it (or the gas-lime) have done their first work in their caustic state, the action of the air gradually turns the poisonous properties to sulphate of lime, and they become a good manure of the nature of gypsum.

If a heavy dressing of this kind was spread on land infested by any grub at the time when it is near the surface, and without disturbing the land, we should

thus take it, as it were, unawares, and it would be destroyed by the poison before it had time to get out of the way, instead of, as is often the case, being merely made to go down to a safe depth, from which it presently comes up again to attack the new crop.

To return to the Chafers. This is one of the classes of attacks which we can as yet only hope to meet by our own observations: where do the beetles feed; what kind of soil do they frequent; *are they attracted by farm manure?* This is a very important point, for the grubs of one or more kinds will leave preying on roots to feed in manure, and it is possible this may attract the Chafers for egg-laying. All these points and many more are what we need to know; and in the next division of injurious Crop Beetles you will see that equally hurtful attacks are put quite in our power by a good practical knowledge of these points.

The fifth *section* of Beetles (*Sternoxi*) is that of the Click Beetles and their allies. The Skip-jacks, or Click Beetles, do little if any harm in the beetle-state, but in the grub-state—that is, as what we know as Wireworms,—the mischief and loss they cause to the country is beyond calculation.

The Wireworms will feed on the roots of almost all farm crops excepting mustard, and live for five years before they cease eating to turn to chrysalids, and thence to Click Beetles. They are of the shape figured, and commonly of a yellowish colour, and take their name from their great likeness to a short thick piece of flattened wire. The Click Beetles are of many kinds (see Fig. 46, p. 59), commonly about a quarter to half an inch long, and about a third of that breadth (of the shape figured), and of a brownish colour, and take their name from their power of regaining their

Fig. 58.—Wireworm, nat. size and mag.

position when laid on their backs by a sudden jerk or skip up in the air, accompanied by a click.

The female Beetle lays her eggs on or a little below the surface of the ground amongst leafage or roots, and especially in such places as grass meadows, or clover leys, where the surface is undisturbed for a time, possibly for years, and consequently the ground below swarms with Wireworms of all ages. When the pastures are broken up these tough-skinned grubs are in no way hurt, but remain in the ground ready to feed on each succeeding crop that is put in until the time for their change comes.

Clover leys and pastures are the main starting-point of Wireworm-attack to our field crops, and the method of treatment may be considered under the two heads: firstly, how to prevent egg-laying and clear infested land before re-cropping or sowing; secondly, how to lessen ravage or support the plant under it if Wireworm is found present in the growing crop.

*To prevent egg-laying* the ground should be made as unsuitable as it can be for the purpose. It is advised to feed down the grass as bare as possible before ploughing, or to go further, and pen sheep on it, gradually moving the hurdles forward, so that every part of the field may be thoroughly trodden. The sheep in this case are fed with Turnips and other regular feeding stuffs, and the amount of liquid and other manure thus worked into the land thoroughly prevents the field being inviting for eggs to be laid on it, and destroys any eggs that might be on the surface. Dressing pasture-land with lime brought fresh from the kiln, and spread hot so as to burn the grass, answers well. Sowing salt at the rate of 5 to 8 cwt. per acre on grass or ley before breaking up has also been found to answer, and good dressings of caustic gas-lime, or of alkali waste strong enough to destroy all live matter on the surface, are very serviceable. Paring the surface and collecting and burning the parings gets rid of a deal of Wireworm, if the burning is done whilst the Wireworm *is in it;* and in

any case gathering up the surface rubbish, and burning it is useful as a preventive, for, even if the Wireworm has left the locks of roots for a time, we thus get rid of the knotted lumps which it would have presently returned to, and which would have kept the land open for its passage.

The habit of the Wireworm in feeding is to keep near the surface, gliding about, as its smooth glassy surface enables it to do, from one plant to another, eating out a piece here and a piece there, and thus injuring the whole crop; and, if this happens whilst the crop is in its first growth, the value even of those plants that struggle through is much lessened. For this reason the main points in preparation of ground to carry the plant over attack consist in treatment that will give a good seed-bed, and mixing the soil with such chemical manures as will be good for the plant and unsatisfactory at least to the Wireworm; also so to clear the ground of rubbish and work it that it may be sufficiently firm (or admit of being sufficiently "firmed" by treatment afterwards) to prevent the travelling of the Wireworm. For this purpose it is advised to plough in good time in autumn, and work the land well so as to get it in good order and consolidated, and either by burning, rotting, or whatever means may be preferred, *prevent it being kept open and full of harbours for Wireworms;* stubble and roots, cabbage stalks or bean haulm, and all such matters, are Wireworm-helpers. If you look down the notes of special applications found serviceable to plough in, you see constantly repeated salt, salt, salt; gas-lime, gas-lime; hot lime, lime and salt; and in a less degree (probably because it is not so well known) alkali waste is also highly recommended. Kainite also is useful, and regular fertilisers, as superphosphate and also nitrate of soda.* But it is worth notice, especially

* The reader is requested to observe that I am in no sort of way advising growing crops, especially Turnips, without a liberal supply of farm manure, but merely, as my business in the matter is to point out where special pests harbour, I just notice that several of them—Wireworm

in preparation of ground for Turnips, that there is a great doubt whether Wireworm is not often encouraged by the use of farm manure. The Wireworms of two of the commonest kinds of Click Beetle have been found respectively in dung and in well-rotted horse-dung. It is considered by some farmers that crops so manured are the most infested, and if we consider that in this manure a large portion of the material is still unchanged vegetable matter of much the same kind as the Wireworms would naturally feed on, it gives a reason for attention to this point. Thorough salting of farm manure has been advised to get over this difficulty. It should also be remembered that heaps of decayed turf are headquarters of Wireworm, unless treated with caustic lime, salt, or the like dressings; also that (take what pains we will) *if grass headlands or grass strips* are left *across or by our fields*, there we make homes of the Wireworms, and they will add all requisite comfortable provision from our crops.

The only crop which Wireworm appears to have an almost complete objection to is Mustard. This, therefore, is useful as a cleaning crop.

When Wireworm *is present*, strong fertilisers—such as nitrate of soda, guano, superphosphate, or others—are serviceable; and mechanical means, such as heavy rolling, are of use, for thus the creature is prevented travelling, and some of the pests are probably set fast and killed. Treading by sheep, or cattle, or by the heavy iron-shod feet of the horses, similarly firms the soil serviceably.

The Wireworm can be drawn away from the attacked plants by dressings of rape-cake or Indian rape, that is, mustard-cake, and in the latter case has been found by experiment to perish in about a fortnight where it had no other food, and, connecting this with the power of

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amongst others—are sometimes found in stable, cow-shed, and other animal manure, and that consequently examination of its condition, and, if found to be infested, due means of remedy, are desirable.

Mustard as a cleaning crop, it suggests further experiment would be useful.

These are some of the main points of Wireworm prevention: prevent egg-laying; clear the ground of Wireworm, and get a good start for the plant; keep up the *strength* of the plant under attack, and keep the power of the Wireworm in check; and also *do not dress your land with Wireworm* either in decayed turf or by letting grass homes for it be amongst your crops. The subject is one of great importance, and therefore, as we have already spent perhaps more time on it than I have a right to seek your attention for, I will just mention that full notes by good agriculturists are to be found in the 'Journal of the Royal Agricultural Society,' part I., for 1883, and also in my 'Report of Observations of In-Injurious Insects for 1882,' published in 1883.

The *sixth section* of this *division* with five-jointed feet is not important to us; it includes the Soft-winged Beetles (*Malacodermi*), such as Glow-worms, and those commonly known as "Soldiers" and "Sailors"; also the Death-watch Beetles, that bore wood. But, excepting a kind injurious to Raspberry plants (*Byturus tomentosus*), I am not aware of their attacks being serious to fruit or crops.

Fig. 59.—Soft Beetle.

# LECTURE VI.

## BEETLES (*COLEOPTERA*).

(CONTINUED.)

### WEEVILS, TURNIP FLEA-BEETLES, &c.

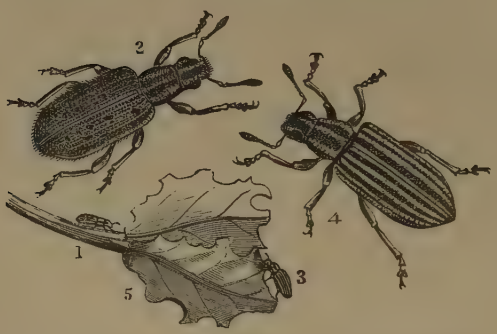


FIG. 60.—Pea and Bean Weevils, nat. size and mag.

THE Weevils and their allies, and the Turnip Flea Beetles and their allies, are what we are now about to study, with a very few minutes observations on the other main divisions, so as to give a connected idea of the arrangement of this great order of Beetles to those who may wish to carry the study further.

We have noticed the kinds that most concern us in the first of the four large divisions; known by having five joints to each foot. (*Pentamera.*)

The next *division* includes Beetles of many different shapes and colours, and amongst them several kinds, such as the Meal-worm Beetle (for Fig., see p. 25), and others hurtful to flour and meal; the Glow-worm Beetle, and others, which we cannot enter on now. This division is known by having five joints to the feet of the two front pairs of legs, and four only to the feet of the hinder pair. (*Heteromera.*)

The *third division* of the order of Beetles is very important agriculturally. It includes the Weevils; the Long-horned Beetles, which mainly frequent timber; and the Turnip Flea Beetles. These three families have all apparently four joints to their feet. (*Pseudo-tetramera*, or *Tetramera*.) See 8, Fig. 63, p. 80.

The *fourth division* will only need a few words. The highly beneficial Ladybird Beetles concern us the most in it. This division has apparently only three-jointed feet. (*Pseudo-trimera*, or *Trimera*.)

We will now go on with the Weevils.

Weevils may generally be known by the head having a proboscis, or snout. This is sometimes short and broad; sometimes curved and narrow, and nearly as long as the whole body; and on the side of this snout the horns are placed. These are commonly what is called "elbowed,"—that is, the lowest joint is long, and the others are joined to it at an angle. Most of the crop Weevils are small, many not so long as a common house Fly, few as long as a common Wasp. They are usually very hard, and much rounded at the sides; and though some are specially named pear-shaped Weevils, this idea of the shape of a pear would fairly describe the general shape of many of this *section*.

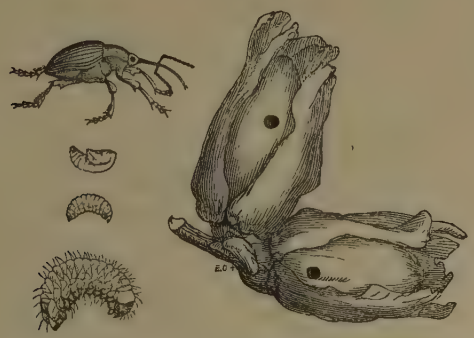

Fig. 61.—Nut Weevil, mag.; maggot, nat. size and mag.; pupa, nat. size. Filbert pierced by Weevil.

The grubs, as far as they are known, are much like the well-known grub of the Nut Weevil. They are white and fleshy, often much wrinkled across, and legless. They are usually a little bent together (like Cockchafer grubs), and have a horny head furnished with jaws. The pupæ are like the Weevils they will turn to, but with the limbs beneath them, and inactive.

The habits of the Weevils differ very much: some of the timber Weevils attack the trees in a completely different way, according to whether they are feeding, or boring for egg-laying; others, such as the Turnip and Cabbage-gall Weevils, cause root-galls by the irritation set on foot by the egg, which they place in the root; but whether the Weevil does much harm or not the grub is always hurtful, and there are many attacks which have so much in common that they may be classed together to be got under by one kind of remedy.

We may first notice some of the attacks that can be lessened by shaking down the Weevils.

The Apple-blossom Weevil (*Anthonomus pomorum*) does much harm by laying its eggs in unopened Apple-buds, where the maggot feeds, and thus destroys the young forming fruit. This Weevil shelters itself during winter under clods of earth and rubbish, and also beneath rough bark on the tree (so that keeping rough ground and bark in order serves much to diminish their numbers); but further, it comes out in the spring, and the females, which rarely fly, crawl on the branches, and drop down on being alarmed. By working on this habit of the Apple-blossom Weevil (and of some other kinds)

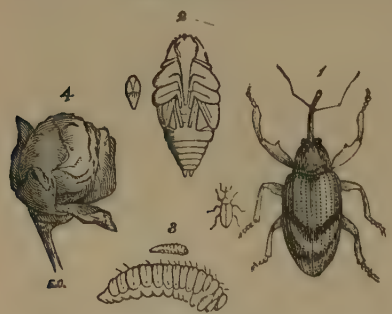


Fig. 62.—Apple-blossom Weevil, maggot and pupa; nat. size and mag.

we may clear many sorts of fruit trees and bush fruit simply by jarring the boughs. Thus the Weevil falls, and we only need to use such plans as common sense will teach us to keep it from getting back again. With the Apple Weevil, or those that are shaken down from the trees, such methods as putting a rough rope, or a ring of anything they will not cross on the ground, round the trunk, answer well. This may be made of twisted hay (or anything preferred), which has been dipped in spirits of tar, or in tar and coarse oil, so that it may keep wet and sticky; or caustic gas-lime may be shovelled round, of course taking care not to hurt the bark.

In Cornwall, where the Pitchy-legged Weevils, or other kinds of *Otiorhynchus*, injure the fruit to an extent causing serious loss in the great Raspberry gardens, it is found to answer well for men to go round with freshly tarred boards, place the boards below a bush and shake,—the Weevils fall on the tar and stick to it. Thus, clearing the Weevils and retarring the boards frequently, the Weevils are got rid of at a paying rate.

The principle of alarming the Weevils, so as to make them fall, may be applied to many kinds of Weevil attack, bearing in mind that the Weevils commonly fall on the *first* alarm; and we must give a little attention to their habits, or they may all have dropped down and secured themselves before we have set about frightening them in full form.

The *Otiorhynchi* (the Vine and Pitchy-legged Weevils) feed by night, and on the gleam of a light they will drop; therefore if a lantern is taken to begin operations with we are apt to find nothing to catch.

The terribly destructive Pea Weevils (see Fig., p. 76), feed by day, and fall at the vibration of a foot, and bury themselves. There may have been hundreds a minute before, but you will very likely not see one; but beat the ground with a spade and you will most likely see them all struggling up out of the earth again; and heavy

rolling in the field, or (probably) scraping up them and the surface earth together in the garden, have respectively been found, or would most likely be found, useful treatment. In any case dressings of hot lime, or anything else that would not hurt the plants but would injure the insects, thrown on the fallen Weevils, would be useful.


Fig. 63.—Turnip Gall Weevil and maggot, nat. size and magnified. Leg of Weevil, magnified. Turnip Galls.

The Cabbage and Turnip Gall Weevils do harm under ground. The female lays her egg on the root or the under-ground part of the stem, or in a hole in it which she forms with her snout; and in consequence of the irritation thus set up the small lumps form, which we know as Galls. In each of these the maggot hatched from the egg feeds, until it is full fed. Then it gnaws its way out and forms an earthen case, in which it turns to a pupa, and thence to a Weevil.

The maggot does not care for cold. It will mend its earthen case if it is broken, and even if it is buried by the galls on the Cabbage stalks being dug in, it appears to thrive as well as if they were still growing. Therefore it is a great object to get rid of all nurseries of future attack by burning or otherwise destroying old stems with galls, instead of throwing them to a rubbish-heap or digging them in; and a change of crop is useful, by presenting food that they cannot eat, or find useful to lay eggs in, to the Gall Weevils that may be waiting in the ground.

These Gall attacks are not very injurious in themselves, but in the case of Cabbage they are often found in connection with Club. They do not directly cause it. The two attacks are quite different, one being a diseased growth set up from insect attack; the other a diseased growth from over-manure and exhaustion, or want of chemical constituents, as lime, and so on, in the soil, or other causes affecting the health of the plant. But still the diseased gall-growth has a tendency to go on to the further diseased growth of the Club, and good dressings of lime are very serviceable to prevent these kinds of attack, both in Cabbage and Turnip. Gas-lime and wood-ashes are also good preventives, and probably kainite, which contains much potash, and which is not nearly as much used as it ought to be, would be very useful. Marl or fresh soil is useful in old garden ground, and deep trenching, which throws fresh soil to the top, and buries the Weevil maggots so deeply that the Weevils from them have not strength to come up through the soil above them, is also a good treatment.

Several kinds of Weevils feed on Peas, Beans, and Clover leaves, doing thereby most serious harm.

The ravages of the *Sitonas* (see Fig. 60, p. 76), commonly known as "Pea and Bean Weevils," may be told by the semicircular scoops eaten out of the leaves. We find these attacks the worst to the leafage of young plants, especially when from weather or other circumstances the plant is kept back, so that it cannot grow away from them; but the Weevils are to be found in legions later in the year, and sweeping these up as they are to be found in the waggons when Clover or Peas are being carried, would get rid of some amount of coming attack. These Weevils lay their eggs at the roots of Clover and Peas, and there the grubs feed on the rootlets, and turn in the earth to chrysalids, about two inches below the surface. The main point we seem to need here is to prevent the settlement of the autumn brood of Beetles. These fly well, and have been found to shelter themselves in the top joint of Corn stubble, and

from this they come out to set on foot attack in *Trifolium* or Clover drilled after. Also it has been noticed that where Wheat-sheaves stood long in harvest-time the Clover on these spots was free from attack in the following spring, although that on the rest of the field was attacked. Acting on these observations, skimming the surface stubble so as to get rid of the shelter has been considered useful; and a good liming, or other chemical dressing, much of which would go into the stubble and make it a very undesirable home for the Weevil, would help us. All measures which will push on good growth are valuable preventives in this case; and in gardens it would probably do a deal of good to lay the drawn and useless haulm along the rows, with any dry rubbish, and burn it. It appears to be the nature of this Weevil to come up, not to go down, on alarm; and we might thus clear out the parents of the next spring's attack.

The small long-snouted "Pear-shaped" Clover Weevil, *Apion apricans*, also does much harm to Clover leafage, but in this case the grub lives in the seed-head, and feeds on the young forming seed; and the best known method of prevention is cutting the Clover before the flower is fully out. These Pear-shaped Weevils (*Apions*) are so very small that they are hardly observable, but the damage to the leafage or patches of brownish heads in a field in flower shows where they are at work.

There is yet one more of the common Weevil attack of the crops to notice,—it is that of a small short-snouted Weevil, which is often found inside Broad Beans, with no signs outside of how it got there. The attack happens thus:—When the Bean-pod is still in its very youngest state, possibly still in the blossom, the Beetle lays its egg there; the maggot, which hatches from it, lies in one of the young Beans in the pod, but the hole by which the egg was put in, or the maggot crept in, is so small that it grows up completely with the growth of the Bean. When the Beans are ripe and garnered, the maggot is there too. It feeds within; and

though it does not prevent the Bean sprouting, yet it lessens the size of the seed-leaves, and consequently weakens the first growth, and thus damages the strength of the future plant. Here our best method of prevention is to examine a sample seed, to find whether it is infested. The maggot turns to a Beetle within the seed; but before it does this it eats a tunnel to the outside, just only leaving the outer skin at the end.

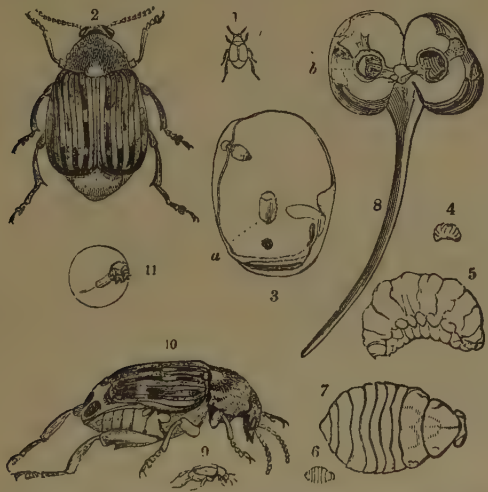


FIG. 64.—1-8, Bean Beetles, grub and pupa, nat. size and mag.; injured Beans; 9 and 10, Pea Beetle, nat. size and mag.; 11, injured Pea.

This having nothing behind it, sinks in, as if a knitting-needle had been slightly pressed on it. By this little round dented-in mark you may know infested seed; if, instead of the mark, there is a small round hole, the Beetle has completed its work within, and has gone. By these two marks you may judge as to the state of seed; and further, if there should be the mark showing the Beetle is still within, it is unsafe to sow, as attack will follow. The Beetles will presently come out, and as soon as the Beans in which they were sown have

grown, and are in flower, their sometime tenants will mount to the blossoms, and lay eggs to start a new attack. The Bean Beetles begin to appear in February, and for this reason autumn-sown Beans are the most likely to be infested, as the Beetles are still within.

Before going on I wish to draw your attention to these notes of method of attack, not being offered you as complete accounts of the history and method of prevention of any of the attacks, in which case any one of them might take up most of the time of our meetings, but as instances of special points to be looked to—of habits, that is—that many crop pests have in common, and of means of treatment, of which some one or other may be serviceable for the attacks of many insects.

In many of the Weevil attacks which we have been studying, treatment of the ground is a great point; as, for instance, where they shelter under rubbish, or down stubble, to clear away these shelters, and put on dressings which will be thoroughly obnoxious to the Weevils, is good treatment. Where the Weevils, or their grubs, are in the ground, it obviously is well to turn them out on the surface, or bury them by trenching so deeply that they cannot come up; and also so to dig in, or otherwise apply, chemical manures, as to make the soil unpleasant at least to the pest, and so good for the plant that it may grow away from attack.

It is in working such points as these that true serviceable plans of insect prevention consist. We need to know the habits of the crop "pests." If we can get them told to us on application, or can study them in published accounts, of course it saves time and trouble; but still these accounts, if they are worth our study, are drawn up from observations of habits just such as we are able to make for ourselves; and if those who depend for their livelihood on the growth of their crops could be induced to believe in their own powers of gaining the needed information, and to use this, as their knowledge of farm operations would point out could be done, it would be an enormous saving to them and to the nation.

But to return to Weevil attacks. There is a class of Weevils which do much harm to some of our forest trees, which may be just alluded to, as the carrying out of farm service much depends on sufficient timber supply.

Fig. 65 shows workings of the Elm-bark Beetle (much like those of the Pine-bark Beetle); and Fig. 66, of the Ash-bark Beetle, which has the entrance-tunnel in the centre, and is then forked.

These various Beetles burrow under the bark, or rather between the wood and the bark, and form tunnels an inch to two or more in length, and along each side of these the female lays her eggs. The grubs hatched from these eat, each for itself, its own tunnel, running more or less at right angles with the mother's gallery, and at the end of these they turn to chrysalids, from which, when the Beetles come out, they gnaw their way through the bark.

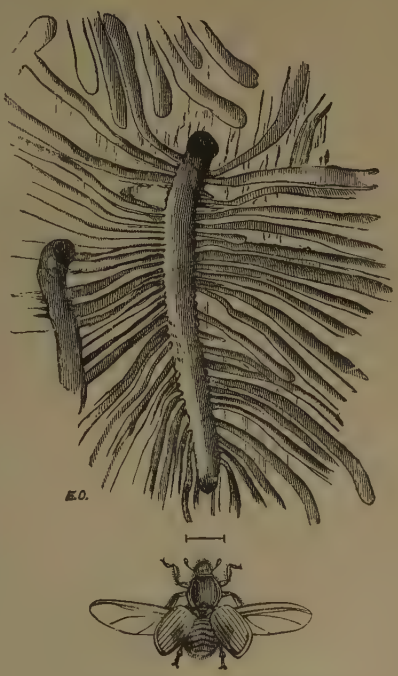

Fig. 65.—Elm-bark Beetle, magnified; and maggot workings in Elm bark.

These Beetles mainly attack, for *egg-laying*, either newly felled trees, or unhealthy timber, or broken timber or stumps left lying about; but though in this respect they do little harm, yet in other parts of their life they do great damage.

One kind of Pine Beetle bores up the shoots, and

another devours the leafage; the Elm-bark Beetle hastens the death of many a tree, which would have

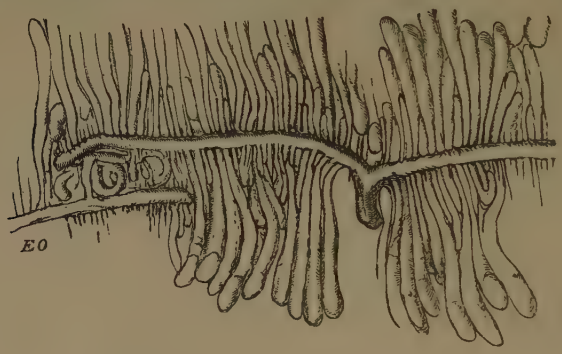


Fig. 66.—Maggot workings in Ash bark.

stood long without the attack; and the Ash-bark Beetle pierces into good wood for its winter shelter. It is highly desirable, therefore, not to allow useless wood to be about, or infested logs, or trees to remain to attract or spread attack; but the details of this forest management we have not space for now.

Fig. 67.—Musk Beetle.

The next *section* of Beetles is that of the Long-horned Beetles (*Longicornes*), of which the grubs chiefly frequent timber. The Musk Beetle (*Aromia moschata*), the narrow dark green Beetle, about an inch, or rather more, in length, with two long thread-like horns, gives

a general idea of the appearance of the Beetles of this section; but we will pass on to the more important one to us of the Turnip Flea Beetles and their allies (*Eupoda* or *Phytophaga*).


Fig. 68.—Oat Beetle, nat. size and mag.; 2, grub; 3. cocoon.

This tenth *section* includes—besides the Turnip Flea Beetles, and some other kinds very like them, which feed on the Hop—the Mustard Beetles (Fig. 69, p. 88), and others which feed (as the Oat Beetle) on the leafage of various field or garden crops; or trees.*

We may know them, firstly, by their (apparently) four-jointed feet; and from the other two sets of Beetles of this four-jointed *division* we may know them by *never*

* The attack of this Beetle may be known by the brownish slug-like grub eating the skin of the leaf in lines, as shown in the figure. The Beetle is not uncommon from spring to autumn on corn or rushes. It is of a deep greenish blue, with reddish orange fore body, and somewhat less than a quarter of an inch long. See Curtis's 'Farm Insects,' p. 307.

having snouts like the Weevils, and by (generally) not having long horns. They are commonly of small size,

Fig. 69.—Mustard Beetle, nat. size and magnified; supposed grub.

oval shape, and bright colour, with the head sunk into the fore part of the body up to the eyes.

The figures will give a better idea of the appearance of these Beetles than any description.

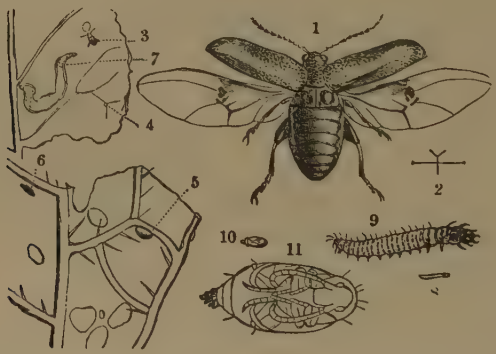

Fig. 70.—Turnip Flea Beetle, eggs, maggot, and pupa; nat. size and mag.

The Turnip Flea Beetles are well known for their leaping powers. They live during winter under clods, or in dry stone walls, or any convenient shelter, and come out with sunshine in spring. Then they feed on any plant of the Cabbage kind; Charlock is

an especial favourite, until the young Turnip plants are come up. Presently they lay their eggs (if on Turnips) on the under side of the rough leaf, and from these the grub eats its way into the leaf, within which it feeds for about six days. It then comes out, buries itself in the ground and turns to the chrysalis, from which the Beetle appears in about a fortnight, ready to begin a new attack.

The first point in prevention is to take care there is as little winter shelter as possible. Lumps of manure and clods of earth on the field; heaps of stones and rubbish, such as are often allowed to lie in corners of fields; large amount of dead leaves on the borders of woods; and dry dykes, or open stone walls—are all winter shelters.

Another point is to let there be as few weeds as possible to keep the "Fly" alive. If it does not find suitable food it will die, or remove itself. It has a power of perceiving where its food is; and such plants as Charlock, or the white-flowering Jack by the Hedge, or Shepherd's Purse, will all help to keep it alive till our Turnips are ready. Thus we may lessen the amount of coming attack; but the great point to depend on for carrying the Turnip crop through "Fly" attack is judicious preparation of the ground,—plentiful supply of enrichment, including a good amount of artificial manure, and liberal supply of seed.

The "Fly" does most harm to the Turnip whilst they are still in the seed-leaves; therefore all means should be used to give a *good start*, and run the plant on in a hearty growth. For this purpose the land should be well prepared beforehand. Where climate allows, autumn cultivation is best. Thus the surface soil is broken down by the winter frosts, and there is a good tilth on the surface, with absence of the clods which shelter Fly, and also give a dry surface on the top, instead of the evenly evaporating surface which suits the young Turnips. When thus cultivated beforehand the land does not require ploughing again in spring; scarifying is enough;

and thus the supplies of moisture which have gathered below the surface during the winter remain undisturbed; whereas if the ploughs are put in, the soil is turned up to a much greater depth, and instead of a mellowed surface with good moisture below, we part with the stores which, in a dry season, would have made all the difference in life or death to the crop. The Turnip plant is of such a succulent nature that the point of supplying it with enough moisture is one of the main things in all methods of starting it.

It is advised to let the land remain untouched for a few days before drilling, with a view to the surface not being dried by exposure just before sowing; and the benefit of what seems just the opposite treatment, namely, *to sow at once*, when partly rotted manure is ploughed in, in spring, is, for the same reason, to secure the moisture. But whenever it may be necessary to work the land, one great point is to secure such a state of under soil and upper tilth as will push the plant on, and by no means trust to a mere good tilth, if it is gained, as is sometimes done, by turning the land over in the sunshine and heat until we fairly see the dust rising, and, as it has been well remarked, it is as dry as if we were making hay. Turnip Fly delights in heat and drought, and the Turnips in just the opposite.

Liberal seeding, 3 lbs. per acre, or more, answers well; for if Fly comes there is a good chance of some of the plants escaping, and if it does not the surplus quantity may easily be removed. In either case, the large number of plants helps towards a hearty start, as the many small leaves prevent the moisture beneath evaporating, as it would from bare earth, and thus keep a damp air beneath the leaves. Good seed is also very important, so that it may sprout at once, and with vigour.

To gain this hearty and rapid growth through the time of the seed-leaves is one of the reasons of applying artificial manure before sowing, or drilling it together with the seed. A few hundredweights of superphosphate,

or other manure suitable to the land, even if there is a good supply of farm manure also, will run the plant on rapidly through the growth of the seed-leaves; and when the rough leaves are come the greatest danger is past.

Where a crop hangs back the use of the water-cart has been found useful, and also putting in the seed with the water-drill; but if weather should be *dry at the time of sowing* there is fear of the small supply of moisture put in by the water-drill causing harm (by the mere temporary effect) rather than permanent growth.

When attack is present various fertilisers have been found to do good by pushing the plant on, but all applications intended to serve by removing "Fly," or killing it, should be used either when the *dew is on* at night or early morning, or during damp by day.

The Turnip Fly leaps away when it finds attack coming; but if the dew or slight rain is on it, it cannot leap because the moisture clogs the hind legs, by means of which it takes its great springs. Therefore such measures as driving sheep through infested fields or laying on special dressings often fail, because they may have been done at the time when the Fly is well able to avoid receiving harm. Turnip Fly attack is one of those that it would be well to enter on if possible in full detail, as an instance of those which only last for a short time, and which we conquer by methods having for the most part very little to do with the insect itself. We know that the Turnip is chiefly in danger whilst in the seed-leaves; we know exactly what will suit its growth in this state, and we make ready the ground accordingly; also we clear away weeds which would support the "Fly" when the crops are not present for it to feed on. These principles may serve also in treatment of the Mustard-seed Beetle (Fig. 69, p. 88). This shelters much in old Mustard straw,—this straw, therefore, should be destroyed; also the old reeds by ditches, where it harbours, and the ditch-growing plants, such as Brooklime and others on which it feeds in spring,

should not be allowed to get numerous. Sowing as early as possible, and sowing Brown instead of White Mustard, because it comes earliest of the two, and thus avoiding the special season of attack, is found to answer, and also a vigorous growth, such as will not go down at once before attack, is of great use. But, in the case of this crop, which is grown to a great extent in special districts, one great means of prevention is more frequent change of crop.

This point of rotation of crop as a means of insect prevention will be alluded to presently. For the present we have only time for an observation on the Ladybird


Fig. 71.—Ladybirds and chrysalis, egg and grub; nat. size and mag.

Beetles. These belong to the remaining *section*,—the *Trimera*,—those that have apparently only three joints to their feet.

We know these Beetles well by sight, and the figure shows the appearance of their six-footed slaty and orange-spotted grubs. Both as beetles and grubs they feed on Aphides of various kinds, and are of such great service in keeping down the Hop Aphis that they should not ever on any account be destroyed.

# LECTURE VII.

## BUTTERFLIES AND MOTHS (*LEPIDOPTERA*).

### Cabbage Butterflies, Surface Caterpillars, Weather Effects, &c.

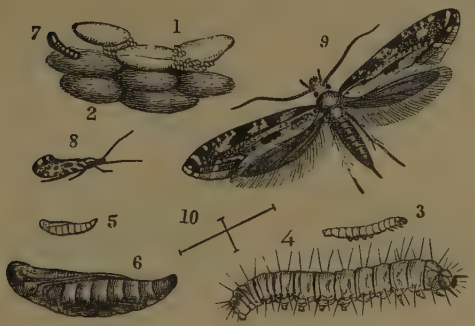


Fig. 72.—Little Grain Moth, caterpillar and chrysalis; nat. size and magnified; and infested Corn.

Before going on with our course of observations I wish you to notice that our object is not so much to give an account of the different kinds of insects which attack our crops as of the chief different *methods* of attack. Thus, by studying the points of some one kind of attack, we see for ourselves that all other attacks which have the same chief points may be lessened by the same kind of treatment. For instance, whether it is grub or caterpillar, or beetle, that is feeding on leafage of trees, if we can make them fall and prevent them going back again, one principle of treatment will answer for them all; and thus it is in many other cases.

Therefore, in the little time that we have now to give to a very large subject, I am, as far as I can, describing all the chief different kinds or classes of attack, and

taking some of the worst as patterns or examples of how treatment has been found to answer in these cases, but by no means alluding to each separate kind of insect.

We will now go on to some of the main points in the habits of the order of Butterflies and Moths (*Lepidoptera*), and observe how far we can bring treatment to bear on the ravages of their caterpillars or grubs. We know them by sight too well to need to spend time in description, and we may know their caterpillars from those of the beetles we have just been studying by their larger number of sucker feet. Besides three pairs of claw feet, and usually a pair of sucker feet at the end of the tail, Moth and Butterfly caterpillars have from one to

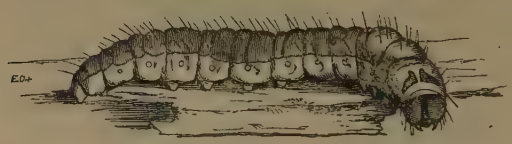

Fig. 73.—Caterpillar of Goat Moth.

four pairs of sucker feet beneath the body ; usually they have four pairs of these prolegs or sucker feet. They have heads furnished with jaws, and are often very prettily coloured, and sometimes beset with spines, sometimes thickly coated with hairs, sometimes with tubercles. When full-fed they moult off their caterpillar-skin and appear as chrysalids, with the forming limbs beneath them, but all still soft and incomplete. A kind of gum exudes from the surface, which, by gradually hardening, protects the insect within, and from this case of thin cement the Butterfly or Moth makes its way out when fully formed in all but the expansion of the wings. These, however, very soon spread to their full extent, and the insect is then complete.

In a general way Butterflies may be known from Moths by having thin long horns ending in a kind of club-like swelling ; also by being day-flyers, and by the

habit, when at rest, of setting their wings upright. Moths usually rest with their wings spread flatly; they


FIG. 74.—1-4, Large White Cabbage Butterfly, eggs, caterpillar, and chrysalis.

have horns of many different forms, some long and thin, some comb-like, others like feathers, and also they

FIG. 75.—Lobster Moth.

often fly at dusk rather than by day, and many are of a much heavier and thicker make than the light graceful Butterflies.

The Butterfly chrysalids (see Fig. 74) may be known from those of Moths by being much more angular, the rows of ridges scooped out or interrupted at distances, sometimes giving almost the appearance of prickles; whilst the Moth chrysalids are oval and smooth.

Fig. 76.—Buff Tip Moth, caterpillar, and chrysalis.

Chrysalids vary very much in their method of rest during this stage. Some, like the Cabbage chrysalis, are slung up by a silken girdle passed round what we may call the waist, which was spun by the creature when about to cast off its caterpillar-skin, as a support during the coming helpless stage. Some hang by the end of the tail from webs, and many go through their change in a silken cocoon (spun like that of the Silkworm by a thread from the mouth) or in earth-cells below the surface of the ground.

In this order a very large part of what we can do to prevent coming attack depends on our knowledge of where the caterpillar turns to the chrysalis state,—that is, whether it buries itself, or forms a cocoon, or hangs itself up in sheltered nooks.

In the case of the White Cabbage Butterflies, of which the caterpillars often do serious mischief in gardens, they have been found not to do so much harm in pro-

portion to field Cabbage, because the caterpillars choose a dry well-sheltered place to change in. For this they


Fig. 77.—Small White Cabbage Butterfly, caterpillar, and chrysalis.

crawl away from their food-plants, and hang themselves by a silken band under eaves, palings, or the like shelter, out of doors, or in any neglected corners in garden-sheds, where they are allowed accommodation, and much may be done to lessen amount of attack simply by tidiness. The collections of old brooms, bits of wood, and dry rubbish of every kind in which they shelter are much better away, whether indoors or out; and a brush taken along angles and in corners, and under stairs, ladders, beams, &c., in garden-sheds, will sometimes clear the chrysalids out by the handful. A search of this kind between the time of the first and second brood in summer, and some time between November and March, would do much good.

It is an excellent principle to keep down the effect of insect-attack by broad measures of agricultural treatment which will carry the plant well on away from the power of the insect; but at the same time it should not be forgotten that when there are a great number of large caterpillars or chrysalids plainly to be seen, and easily to be laid hold of—whether with fingers or by other means—that the best thing to do then is forthwith *to lay hold of them*. In some cases hand-picking is perfectly ridiculous, but in some it is not only a sure cure,

but a very cheap one. It does not follow because it is hand-picking that the caterpillars, or what not, are to be taken off one by one, or that men, at a proper man's wage, are to be employed; but if children are shown precisely what they are to do, and paid so much per hundred or per pint, they will soon prove of great service. In Germany hand-picking is much used. It is noticed at what time of day the moth or beetle, or whatever it may be, is most sluggish; commonly this is on damp sunless days or early in the morning. When it is known what the best time is, the women or children shake the attacked plants above baskets, or above anything that will catch the falling creatures, be they caterpillars or anything else, and thus at a small sum they are collected and destroyed.

There are not many kinds of *butterfly* caterpillars

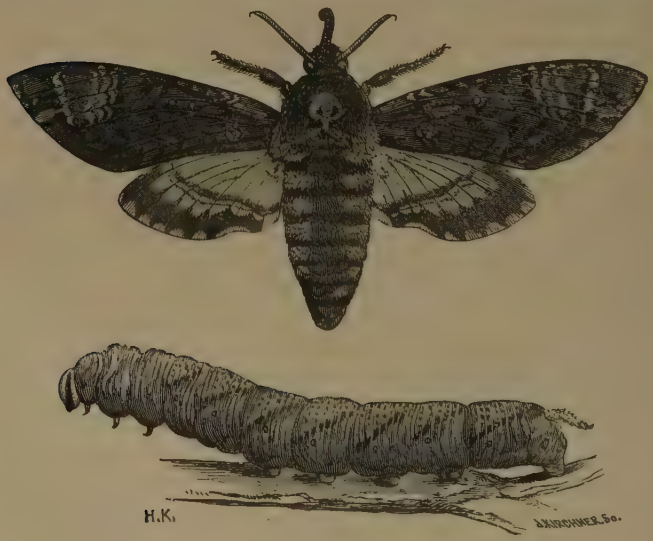

Fig. 78.—Death's Head Moth and caterpillar.

which are hurtful to crops in England, but amongst the hosts of different kinds of *moth* caterpillars that cause

great loss, about the very largest of all, which is that of the Death's Head Moth, is best got rid of by hand-picking. This now and then does much harm to Potatoes by feeding on the leafage. The caterpillar is as much as four or five inches long, and as thick as a finger. It is yellowish, with slanting blue or blackish and white stripes on the side, and, like most of the caterpillars of this family of Hawk or Sphinx Moths, has a kind of horn-like growth, like a short curved and pointed tail. This richly-coloured brownish Moth is the largest of the British kinds; it is known by its back being marked with a figure like a skull, whence its common name of Death's Head Moth.

The caterpillar usually hides by day, and feeds in the evening or at night; therefore, when great harm is found to be going on (either in this case or others like it) from an unseen enemy, it is well for some trustworthy person to watch at dusk or dawn for what is going forward, and with large creatures like these caterpillars a very small quantity of light will be enough to see them by as they gently move the leafage in feeding. When full-fed the caterpillar goes down into the ground to change, therefore turning up the chrysalids is an easy measure of prevention with this Potato-feeder.

Fig. 79.—Eyed Hawk Moth.

This family of Sphinx or Hawk Moth are chiefly of large size, and of the shape of the Eyed Hawk Moth

figured. The caterpillar of this feeds on Apple and Willow, and is rough, of a pale green with white stripes on the side, and has a blue tail. The caterpillars of the Sphinxes are mostly much like this and the caterpillar of the Death's Head in shape, and this family deserves a word on account of its great beauty; but the habits of the various Moth caterpillars do not differ nearly so much among themselves as those of Beetle grubs. Some caterpillars of several families of Moths bore up stems or timber; some of several, or at least of two, families work together in great parties, which form webs for their head-quarters; some of many of the families bury themselves to turn to chrysalids. We will therefore look at the class of habits together, and first take the borers.

There is one family amongst these known as the Clearwings, which differ from other Moths in the body being usually straight and narrow, and the wings so transparent that they much resemble Flies, Wasps, or other transparent-winged insects, from which they are consequently scientifically named. One of the largest is the Hornet Clearwing, the caterpillars of which infest the Osier.

Fig. 80.—Hornet Clearwing.

The caterpillars of the Clearwings are white fleshy grubs, with altogether sixteen feet, and they feed in roots, wood, branches or shoots of trees, and turn to chrysalids in the gallery which they have eaten. The Currant Clearwing sometimes does much mischief. The egg is laid early in the summer in some crevice such as is often to be found on old or badly-trimmed trees; from this the caterpillar, as soon as it

Fig. 81.—Currant Clearwing.

hatches, eats its way into the branch, and for several inches downward feeding on the pith as it goes, and feeds or lives within the bough in the caterpillar-state till the following March.

The chrysalis is to be found about the beginning of May. Where large branches of Currant bushes wither away, or young shoots fade without known cause, it may be suspected that this caterpillar is within, and splitting the shoot open will soon show whether it is there. If so, all shoots that are—or are suspected of being attacked—should be cut off and destroyed, but the best preventive is trimming that will not leave numbers of old neglected boughs in the bushes.

Where caterpillars bore into *solid growing* wood something in the way of prevention may be done (to begin

FIG. 82.—Goat Moth and chrysalis.

with) by noticing what part of the tree is commonly chosen by the Moth for egg-laying, and using means to protect this. The Great Goat Moth is considered to lay

its eggs chiefly at the lower part of the trunk; the Leopard Moth on the trunk and branches; and, in the

Fig. 83.—Leopard Moth (female); head of male.

first case at least, by good rubbings and brushings with a thick mixture of soft-soap many eggs may be destroyed, and the bark made wholly unattractive for laying. The Goat Moth caterpillar may be known from all others by its great size* (for it is three inches or more in length), joined to its yellowish colour, with reddish patches or stripes down the back and black head, and the strong and peculiar smell from which it takes its name. It bores into the live wood, and lives there for three or more years before turning to the chrysalis, and the means by which it can be attacked in its burrow are applicable to many timber-burrowers.

Something may be done by thrusting a stout wire up the boring; if the end comes back moist with white matter on it the caterpillar has been reached; or, by means of a hooked wire, the caterpillar, when feeding near the outside of the tree, may be drawn out. Another very good plan, when the caterpillar is further in, is to inject paraffin by means of a sharp-nozzled syringe into the tunnel,—any other fluid poisonous to the caterpillar would do just as well; soft-soap or tobacco-water, for instance, or fumes of anything poisonous, such as sulphur or tobacco, might be applied

* See figure of caterpillar, about half-grown, p. 94.

in the same way; and a bit of soft clay kept well pressed up to the mouth of the hole, so that it might be forced in like a plug as the syringe or tube was withdrawn, would keep the application from escaping. This seems a very simple thing to name, but for want of it an endless amount of damage goes on to the fruit and forest trees, both at home and in the colonies. Sometimes there are as many as sixty of the Goat Moth caterpillars in one tree. I have myself seen up to that number taken from an Elm, and in such cases cutting down, and destroying the caterpillars, is the best prevention for the spread of mischief.

Various kinds of Moth caterpillars do much harm to Apple trees and Hawthorn hedges by forming large masses of web, in which they collect in bad weather or at night, and use as a kind of general tent for the family to come out from and forage. These whole families may be got rid of by cutting off the web-nest when the tenants are within, and letting it fall into a pail, so that none may escape, but be carried away safely to be destroyed.

I have not available figures to show these attacks; but one of the commonest kinds of these is the Lackey Moth, so called from its gaily striped caterpillars, produced from the rings of eggs, which it lays on the twigs of Apple or other trees which it may frequent.

The small Ermine Moth is another very common pest. This is a very small Moth, not much larger than a common Clothes Moth, is of very variable shades of grey, and the fore wings often livid or whitish, and dotted with black. The increase of this may easily be checked, as the caterpillars turn to chrysalids *within* the webs.

The various kinds of attacks of Moth caterpillars are so many, and the injuries they cause so great, and the time now allowed to consider them so small, that whatever point we study seems at the cost of leaving out something else of importance; but in these short dry details I have tried to draw attention to some four or five principles of preventing or remedying attack.

One is taking away shelter (as in the case of Cabbage caterpillars).

Another, the possibility of hand-picking, shaking, gathering, or whatever term we use for it, being so managed as to be a practicable and paying operation, instead of a ridiculous loss of time.

Another is prevention of egg-laying on fruit bushes, by keeping them so properly pruned that there is no attraction of cracks and crevices, or in the case of larger trees stopping these hiding holes up with a good filling of soft-soap, or anything that may serve the purpose. We have also noticed that the caterpillars may be smoked or poisoned in their burrows,—a simple piece of knowledge, but yet one which some few years ago would have been of great service in saving Coffee shrubs in one of our colonies; further, we have noticed that with webbing caterpillars it is decidedly well before we pay our visit to see if the family are at home.

These, I trust, may be thought useful points just to notice. And now—without entering on the vast number of attacks to stored Corn, such as that of the Grain Moth (see Fig., p. 93), or to butter, or many other attacks directly connected with farming, which we suffer from Moth caterpillars—I propose to give the remainder of our present time to what are known as surface caterpillars, and their allies.

The family of Moths which these belong to is termed *Noctuidæ*, from the circumstance of many of them flying chiefly in the dusk or at night. The Turnip Moth,* Cabbage Moth, Great Yellow Underwing,* and some other kinds, of which the caterpillars more or less frequent the surface of the ground, do infinite harm, both in field and garden. In some cases, like the Turnip Moth caterpillar, they feed at or below the ground-level on almost every common root crop, or corn crop, they can reach; and when the weather is too severe in winter for them to continue feeding in the Turnip bulbs

* For figure of Turnip (or Dart) Moth, see p. 1; Great Yellow Underwing, see p. 3.

they simply go down deeper for a time, and after coming up again to feed turn to chrysalids in the ground in the following spring or early summer. Others, like the caterpillars of the Cabbage Moth, feed in the hearted

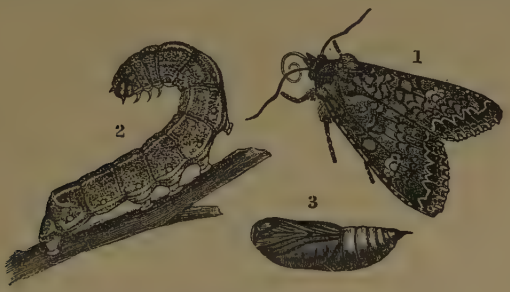


Fig. 84.—Cabbage Moth, caterpillar, and chrysalis.

Cabbage, and turn to chrysalids in or on the surface of the ground before winter. But whatever slight difference there may be in the habits of these various kinds of thick fleshy caterpillars, about an inch and a half long, which we only too often find either at the roots or on the leaves of the Cabbage and Turnip, this special point of their usually passing the winter under ground puts them very much in our power.

Before the caterpillar turns to the chrysalis it makes a cell in the earth, in which it is protected from wet and sudden changes of temperature, or it seeks or prepares a safe resting-place for its change, or for a time; and so long as the caterpillars are thus protected no amount of cold which they are exposed to here will, as far as we know, do them the least harm. But if they are thrown out of these shelters to the influence of drying winds or hot sunshine, or to lie soddening helplessly on the surface in moist or muddy ground, or to being frozen in these states, then their constitution will not bear it. To quote one of our chief American authorities,—"It is evident that freezing does not injure the cut-worms" (as these surface caterpillars are called in the States), for nature

has prepared them for it, but *freezing in connection with loose wet soil*, and this will kill the chrysalids as quickly as it will the worm or caterpillar. This is one of the great principles of prevention:—*Turn out the insect pest from its natural shelter, when it is in such a condition that it cannot regain it or make a new one.* It takes a little observation of the habits of the creature to manage this properly.

If the caterpillars are turned up too soon, that is, either before they are torpid, or before they have changed to the chrysalis, they will simply go down again. If the soil is turned up when they are gone down *very deep*, they will not be the worse for what has been done above them. Each worker must look a little for himself, for dates and habits differ with climate and other things, but a little careful observation made by turning over the earth, so as to see where the creatures are, will be well repaid. They are quite large enough to be easily seen, if they are in numbers to need attention. This principle may be worked both in winter and summer,—with caterpillars that turn to chrysalids under ground or in cocoons above ground, and with those that frequent leafage of trees or roots of grass, as well as those we have spoken of.

It should always be remembered that when a concourse of caterpillars suddenly vanishes (without being cleared off) that the creatures are not gone; they have only gone away to change to chrysalids in a safe place, and will reappear presently in a new shape, ready to start a new attack. They will usually be very near their food-plant: grass-feeders will most likely be in the earth beneath the grass; at least they certainly are in the case of the Antler Moth, of which the caterpillars feed at the root of pasture grass, and sometimes appear in vast numbers. The common Cabbage and Turnip surface caterpillars are to be found as chrysalids on or in the ground, near where they fed.

Fig. 85.—Antler Moth.

The Beet and Mangold Moth (Silver Y Moth) caterpillar spins a cocoon on, or not very far from, the plants it infested; and in all these cases, and scores of others,


Fig. 86.—Beet Moth, caterpillar, and chrysalis in cocoon.

much good may be done by turning up the chrysalids, destroying the weeds they harbour in, and using all other methods of treatment, which a moment's thought will suggest, to destroy the pests.

Clearing all weeds that attract the Moths is one method of preventing increase. The constantly increasing amount of insect attack is in part because of the constantly wider spread of cultivated land. There is much greater amount of special crops, such as special insects feed on; and instead of there being, as in wild districts, perhaps, one plant in a hundred that may suit the caterpillar, there are districts all through the country where nine-tenths of the growth are its chosen food. If, therefore, in addition to the crop food we let weed food collect in our borders, we add most needlessly to our troubles; and by clearing and burning these patches round garden and fields we may do a deal of good.

The enormous appetite—or necessity for eating—of some of these great caterpillars may be used as a means of getting rid of them. Where land has been infested with Turnip caterpillar, it has been found that by ploughing and cultivating it so that there is no food,

and letting it thus remain for a fortnight, that the caterpillars may be starved out, or will go elsewhere.

When attack is bad the chief thing to trust to is fertilizing dressings; but sometimes dressings of gas-lime on the land and on the plants will check attack to a serviceable extent. This has been found useful in the attack of caterpillar to hearted Cabbage in the autumn. The gas-lime falls down among the leaves, and thus fills the parts where the caterpillars shelter by day, with what, to a certant extent, keeps them out, and is not pleasing to them.

With regard to hand-picking caterpillars from the roots, it is often said this cannot pay; but it is a regular process in some places where field Cabbage is grown; and on once asking a grower as to it answering, he simply remarked, "If we do not do it we lose our Cabbage." The grubs may be quickly cleared by women turning the soil back at the root of each plant, putting the grub or grubs in a flower-pot, and turning the soil on again. In these kinds of attacks it is quite worth while to reckon on paper the comparative cost of the total or partial loss of crop to be expected, and that of the remedy, and proceed accordingly. Grubs of the kind we are speaking of now commonly go on from one plant to another, and cause severe loss,—each morning shows the new fallen plants; and the grub will so continue eating till it turns to the chrysalis. But it is easily seen; and once *caught* we have made a *sure cure*. This sureness of the cure is the thing to be thought of before trying it. It is often advised to sprinkle lime; but lime slakes very quickly, and, excepting as a manure, does not do nearly the good that is supposed. Dry dressings often entirely fail in effect, because they often do not adhere to the caterpillar; and if they do, very likely they do not hurt it.

It has, however, been observed that sudden moisture, especially after hot weather, will destroy Moth or Butterfly caterpillars. They have been recorded by our great authority, John Curtis, as being found, in such

circumstances, emptied of their contents, and like mere skins; and in the great attack of Beet Moth caterpillars, in 1879, many were thus killed in Essex.

It is difficult to work this knowledge to get rid of leaf-feeders; but in cases where ammoniacal liquor or lime water are found useful in getting rid of ground caterpillars, I incline to think that the sudden soddening of the ground round the plant has effect on the caterpillar as well as the nature of the fluid.

The treatment for prevention of surface caterpillars may be shortly described thus:—Turn them up by cultivation where land is known to have been infested; and where catch-cropping is practised let the field be cleared of all food at least a fortnight before a new crop is put in; keep up the strength of the crop, but use remedies if you can,—if they will be sure to destroy the grubs.

In a very large number of attacks it is the worst possible practice to try to work *directly on the grubs;* you must counteract their mischief, rather than try to get literally hold of them; but with the large Moth grubs, which are often one, instead of a score or hundreds, to a plant, the case is different.

For the same reason birds help us much with some kinds of Moth caterpillars. They can bore down, and draw out these large grubs without the broadcast destruction which often follows on their services in searching for Wireworm.

The crow, raven, jackdaw, rook, and partridge, are all said to be of use in clearing away the caterpillar of the Turnip Moth; and in the case of some of the swarms of small caterpillars which attack forest trees, especially in the case of the Small Green Oak-leaf Roller, the flocks of birds which collect when great attack is going forward are our only helpers.

But throughout the attacks of this order, I would advise, if you do not *know* where the caterpillar turns to chrysalis, to look beneath the attacked plant for the small (or large) brown cases, of the shape so often

figured, and turn up the ground, put on caustic gas-lime or alkali waste; or, in gardens, burn the rubbish,

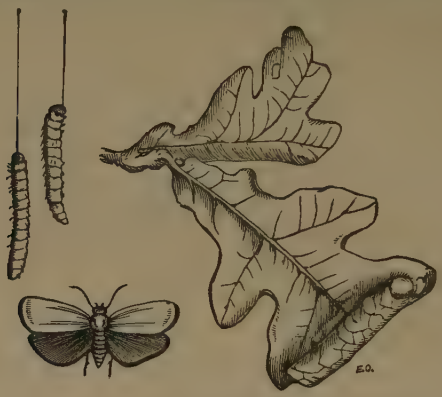

Fig. 87.—Oak-leaf Roller Moth and caterpillars.

like Pea haulm, along the rows, so as to destroy chrysalids of the Moth, which are in the earth for the winter; or

Fig. 88.—Pea Moth and caterpillars, nat. size and magnified.

trench down the surface, so as to bury the enemy; and thus, if you do not check the attack, you probably may prevent a repetition.

These are but a few of the points to be considered in this vast order; but I have endeavoured to choose some of what seem the most important; and the want of space must be my excuse for the great omissions.

# LECTURE VIII.

## SAWFLIES, ICHNEUMON FLIES, WASPS, &c.

(*HYMENOPTERA.*)

TURNIP SAWFLY, PARASITE MAGGOTS; DESTRUCTION OF BIRDS; &c.

FIG. 89.—Hornet.

IN the order which we have just been studying there is a great likeness throughout, both in the manner of life and in the kind of transformation of all the kinds; but in the order which we are now going to study the habits of life of the different families vary very much.

The first division, that of the Sawflies (*Tenthredinidæ*), is exceedingly hurtful to various crops and trees by the ravage of its caterpillars to the leaves, or in some cases to the fruit; also in some cases by causing Galls. The second division, the Sirexes (*Uroceridæ*), feeds in the caterpillar state in timber. A third, that of the Gall-flies (*Cynipidæ*), inserts its eggs in various parts of plants, thereby raising the strangely formed growths we know as Galls. And other kinds, commonly known as Ichneumon Flies (*Ichneumonidæ*, &c.), instead of inserting their eggs into plants, help us greatly by inserting them into other insects, in which the parasite grubs feed quietly on the living material, until their hosts

sink beneath the task of supporting their unwelcome guests.

Besides these families, which concern us much agriculturally, there is a large division, including different kinds of Ants, Bees, and Wasps, known by reason of most of them possessing a sting, as the division of *Aculeata.**

We need just to observe what the general appearance of the insects of this order is in each of the three stages; but the families which I wish you chiefly to notice are those of the Sawflies, which are very injurious, and the Parasite-flies, which are very helpful to us.

We may know the insects of this order, in a general way, by their likeness to common Wasps or Bees. They have two pairs of membranous wings; a mouth, sometimes furnished with short and thick, or with long and narrow, pincer-like jaws (*mandibles*), as in Wasps and Sawflies; and sometimes also with a kind of tongue, suited for collecting moist food, as in the case of the Bee. This *trunk* (as it is often called) is formed of the feeler-jaws and lower parts of the mouth *in a much lengthened condition.*

The females have the abdomen supplied with an apparatus which acts in some cases as a sting; in some as a piercer, by which they can insert their eggs into other insects, or wherever they may select; and in some this *ovipositor* (or *egg-placing apparatus*) is formed of several pieces, acting together like a saw, whence one division takes the name of Sawflies. The grubs are for the most part legless (much like the well-known Wasp grubs); but it is important for practical purposes to notice that the Sawfly division may, with very few exceptions, be known in the caterpillar state from others of this order, and from all the other kinds of caterpillars which we have noticed, by having a *larger number* of sucker-feet. (See Fig. of Turnip Sawfly, p. 116.)

The Sawfly larvæ, or caterpillars, have three pairs of claw-feet,—like the caterpillars of Butterflies, and of

* From *Acus*, a needle.

some Beetles; but, with few exceptions, they have six to eight pairs of sucker-feet. They are often called caterpillars, and much resemble Butterfly caterpillars, both in shape and in being often prettily coloured; but they may (with the exception of the Corn Sawfly, and a few others) be readily known from Butterfly or Moth caterpillars by the larger number of sucker-feet. When there are twenty-two feet *in all*, that is, counting true claw-feet, sucker-feet under the body, and pair of sucker-feet at the end of the tail, it will be seen there is only one segment of the body that is legless.

When full-fed the Sawfly caterpillars often go down into the ground, and many of them spin cocoons; and the change to the chrysalis takes place in a few days in summer: later in the year the caterpillars lie many months unchanged. They pass through the chrysalis state in a fortnight, or less time. The chrysalis (like most others of this order) is inactive, but has the limbs folded beneath it, much in the same way as the Beetle chrysalis.

FIG. 90.—Pine Sawfly, caterpillar, and pupa; magnified. Pine leaves injured by caterpillars.

The shape of the Sawflies is shown by the figures.

They may be said to be very like small square-made Wasps, but with the abdomen closely applied to the body, instead of being stalked.

Sawfly caterpillars are most voracious, and, though they do not feed exactly in parties, they are often found together in such vast numbers on the trees or crops they attack as to cause serious loss.

The Pine Sawfly caterpillar does great damage to Pine plantations or forests in Scotland; the Gooseberry Sawfly is a severe evil almost every year: and these two attacks might be perfectly easily kept in check by utilising the habit of the caterpillar of going down for the winter, and lying in cocoons beneath the branches they have been stripping of their leaves.

Where Pines have been infested some of these small oval cocoons may be on the boughs, but most of them will be found beneath the tree, and most likely near the trunk, lying a little below the surface, or amongst the dry leaves or moss, or forest rubbish, sometimes in masses as large as a man's fist. By collecting these, or by collecting the surface soil, or by skimming the rough herbage and heather, and charring it in heaps (taking care of course to go down to the depth at which the cocoons may be found), the amount of the following year's attack may be much lessened.

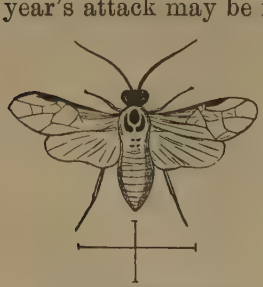

Fig. 91.—Gooseberry Sawfly.

Exactly the same kind of treatment is the best way of keeping Gooseberry Sawfly caterpillars in check. They winter in cocoons under the bushes; therefore if any trustworthy person will turn over the soil to see the depth at which the little brown cocoons lie, the earth may be scraped away to three or five inches depth, or whatever depth the caterpillar may have gone down to, according to the nature of the soil, and carried away and disposed of, so that when the caterpillar has turned

to the chrysalis, and the chrysalis has turned to the Sawfly, the Sawfly may not be just where it has only to walk or fly (as it may prefer) to the boughs close by to find itself at home in the Gooseberry leaves, and waste all our trouble. This is a point requiring attention. In one of the great fruit-growing districts, where Gooseberries were grown in acres, I have seen the clearing of the soil from beneath the bushes well attended to, but when scraped out it was left between the rows; and the result was a hearty attack.

These caterpillars sometimes migrate in bodies, and then are completely in our power. If seen crossing a road, or from one field to another, there should not be an instant's delay in destroying them by the readiest means at hand. Trampling on them would be a complete cure when they are on the open ground of a road; and (when moving from one field to another) if a couple of men were set to run a long strip of turf off across the line of the advancing army, or beat a line of earth flat with spades, there would be a clear space on which the caterpillars might be seen and crushed (or destroyed in any convenient way) with certainty.

The treatment of turning out the caterpillars in the winter is the best method of getting rid of attack on permanent crops, whether on timber, fruit trees or bushes, or grass pastures. As far as is known the caterpillars of the Grass Sawflies (*Dolerus*), which sometimes are common in pastures, go down, *but do not spin cocoons to rest in*, so that throwing them out in their unprotected state is an almost sure way to "stamp out" such centres of future attacks.

The Turnip Sawfly sometimes causes overwhelming mischief, but this is not a regular yearly attack, by reason of rotation of crops; and also that in regular course of autumn cultivation the cocoons are thrown up, or buried beneath their natural resting-places.

The progress of the injury is very rapid. The bright orange Sawflies lay their eggs in slits sawn in the leaves. One female will lay over two hundred eggs.

The eggs hatch in about five days; the time varies with the state of the weather,—if warm and favourable they will hatch sooner. The twenty-two-footed grubs are greenish at first, then black, then slaty, and are full-grown in about three weeks, during which time they eat

Fig. 92.—Turnip Sawfly, mag.; caterpillar, pupa, and pupa-case.

voraciously. They go down into the ground to change, and the new brood of Sawflies in summer comes up, ready to lay eggs and start a new attack in about three weeks. With this attack we can, as with most others, do something by ensuring vigorous plant-growth; but all methods that have been found useful to check attack will be found to be based on the special habits of the caterpillar.

During its three weeks' life it changes its skin about once a week, and to manage this it must hold fast, by means of the pair of sucker-feet at the end of its tail, to a leaf or stem, so as to have something to drag against in the struggle to get free of its cast coat. If it cannot do this it dies. Also it has only the power of spinning a thread to let itself down, or come home again by in passing alarms, during the first few days of its life. After that, if it falls to the ground, it can only return by crawling.

The remedies which are chiefly used all turn directly

on these habits. The plan of driving sheep through an infested field, or of brushing the plants with boughs, either carried by hand or fixed on a scuffler; or, again, dragging a cart-rope over the plants;—all turn on endeavouring to make the caterpillars loose their hold, which we see amounts, with a large proportion, to the same thing as killing them outright.

As in the case of Turnip Flea Beetle, various kinds of dressings may be of use, such as lime and soot, gas-lime, &c., if applied so that they stick to the insect and leafage; and also all measures to keep the earth moist enough to run on a good crop, and keep the Sawfly from enjoyment of the full light, heat, and drought, in which it delights, will be of service.

There is one other kind to be noticed, because it differs greatly from those just named in its habits. It is the Corn Sawfly (*Cephus pygmæus*), which feeds within the corn-stalk; and its presence may be known by the blasted ear.

This whitish maggot has only the rudiments of the three pairs of claw-feet; and when its work of mischief to us is done, it rests for the winter in a silken case, very near the ground-level, in the old corn-stalk. To prevent attack recurring it is a perfect treatment to gather together the infested stubble and burn it.

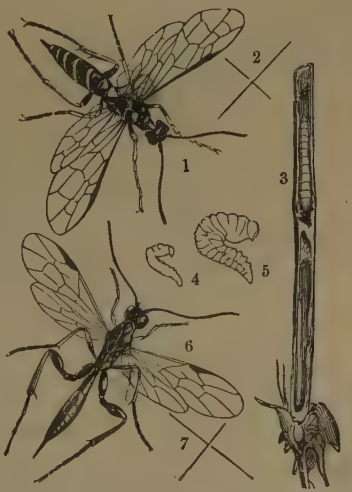


Fig. 93.—1-5, Corn Sawfly and grub, natural size and magnified; 6 and 7, Parasite Ichneumon Fly, magnified, and nat. size.

This is an exception to the usual form of life and place of change of Sawfly larvæ, therefore must be treated differently; but there is the same principle to

be followed as with caterpillars and chrysalids of other kinds of Sawflies, and also of Butterflies and Moths,—that is, firstly, to find out where they pass the winter, and then to turn them out from their shelters.

The amount of injury caused by Sawfly caterpillars, and especially from time to time by that of the Turnip Sawfly, is so serious that a great deal (of more or less use) has been written on the subject; but we are only able now to point to the main principles of prevention, and must pass on with only just a few words on the timber-borers of this group, and on the Gall Flies, to the Ichneumon Flies and Parasites, which are of great importance practically.

Just to show that there are such insects, I give a figure of one of the Sirexes and its grub, as one of the

Fig. 94.—The "Common" Sirex and grub.

family of *Urocerida*, which do much harm to Pine timber; and also give a figure of the Marble Gall, together with its Gall Fly, grub and chrysalis, to give a general idea of the family of *Cynipidæ*, or Gall-makers; or Gall-wasps, as they are well called on the Continent.

The female Gall-wasp has a kind of pointed tube, or arrangement of bristles, by means of which she is

able to insert her egg or eggs into whatever part of the plant she chooses for the purpose. In consequence of

Fig. 95.—Marble Galls. Gall Fly, grub, and pupa; magnified.

this various growths form, such as the Oak Marble Gall; the Oak-apple; or the Spangles of the Oak-leaf; or the

Fig. 96.—Spangle-galls on Oak-leaf; ditto, magnified.

bright green and red moss-like bunch, which we know as the Robin's Pincushion of the Rose;—and within these the legless maggots hatch, feed, change to chrysalids, and in due time from them they emerge as Gall-wasps, more or less resembling the one figured; but they are not mentioned for your special attention now, but merely to notice their existence.

The families of the Parasite Wasp-flies are important

to us, as a means of keeping the increase of other insects in check.

One division of these is that of the Ichneumon Flies. These are much like the Ichneumon parasite of the Corn Sawfly, figured at p. 117. They are light made insects, with a longish body and abdomen; long legs; a small head with long horns, often having a ring of white on them; and an ovipositor, sometimes short, sometimes long, and often permanently extended like a large and long sting. With this they insert their eggs, for the most part into the grubs of other insects, but sometimes into their eggs, and occasionally into the chrysalids; and those kinds furnished with long ovipositors pierce with them through bark or solid wood, and thus insert their eggs into Beetle grubs, or whatever their selected victim may be, which, although


FIG. 97.—1 and 2, Corn Aphis; 3 and 4, wingless infested specimen; 5-8, Parasite Ichneumon-flies: all magnified, with nat. size.

out of sight, their instinct tells them is within, ready to act as food to their maggots. It appears that Ichneumon

Flies, excepting in one doubtful case, do not lay their eggs in insects which are in their *perfect state*, save in Aphides; and here they give us help which nothing else affords.

In the case of Corn-ears which are infested by Aphides, often known as Green Fly, you may see that many of the Aphides, instead of being of the natural colour, are of a rich brown, or almost black. These have been killed by the Ichneumon. The female of the *Aphidius* (see Fig. 97, 5, 6) inserts a single egg into the abdomen of many Aphides, one after the other, and the maggot, which hatches from the egg, consumes all that is eatable, until its live host is reduced to a state which will not carry on life any longer. Its uninvited guest goes through its changes within to an Ichneumon Fly, and presently quits the hardened skin, which is distinguished, as we just observed, by its colour. Sometimes every Aphis on a Corn-ear is thus destroyed, and there are other kinds of allied Parasite Flies which help us similarly.

One of the forms of attack which is the plainest to be seen is that of the Cabbage Ichneumon Fly (*Microgaster glomeratus*). This little Fly lays a vast number of eggs, sometimes more than sixty, in one caterpillar of the large Cabbage Butterfly. Here the maggots hatch and feed, avoiding by instinct such parts as the consumption of would be a fatal loss, firstly, to the host, consequently to the guest. The containing caterpillar—the live food, that is—meanwhile feeds and grows, not only until it grows to its full size, but it may often be known from uninfested ones by its swollen appearance. It has not, however, power to turn to the chrysalis state: when the time for this comes the maggots within pierce its skin, and each one spins for itself a small cocoon of yellow silk, in which it goes through its changes to the complete insect by the side of the dead body of the exhausted caterpillar. These little Ichneumon Flies are one of our protections against great increase of the caterpillars, and the small silken cocoons, which are easily seen when

they lie together in masses on Cabbage leaves, should never be destroyed.

Another kind of small Ichneumon Fly (*Hemiteles melanarius*) preys in the same way, by means of its maggots, inside the chrysalids of the Green-veined Cabbage Butterfly. These infested chrysalids may be

Fig. 98.—1-4, Green-veined White Butterfly; 5 and 6, Ichneumon Fly (*Hemiteles melanarius*), magnified, with nat. size.

known by their dark brown colour, and should never be destroyed, as each one is a case—a package, so to say—full of checks to a troublesome crop preyer.

You will notice that these Ichneumon Flies are all very much alike in shape, and that their wings are much veined.

The *Parasite* Wasp-flies of the two other families, which are most important to us (*Chalcididæ* and *Proctotrupidæ*), are for the most part very small, with almost, or quite, veinless wings.

Fig. 99. — Parasite of chrysalis of Cabbage Butterflies, magnified.

The *Pteromalus puparum* (Fig. 99, magnified; Fig. 74, 5, p. 95) gives a sketch of one of the kinds which destroys chrysalids of the Large and Small Cabbage Butterfly. This very small Fly is

stated to lay its eggs on the outside of the chrysalis as soon as it has cast off its caterpillar skin, and is still soft and tender. The maggots from these eggs soon hatch and eat into the chrysalis, and sometimes as many as from two to three hundred live thus in one chrysalis, where they change to the perfect Parasite Fly, and come out soon in summer to continue the useful work. In winter some remain in the chrysalis.

The use that these *Pteromali* are of is well shown by their work in North America, in checking increase of Cabbage Butterfly.

The Small White Cabbage Butterfly made its appearance (or at least was first observed there) at Quebec about 1859, and gradually spread and caused much damage, but for several years no Parasite appeared to check it. In 1871—that is, about ten years after the appearance of the Butterfly—it was announced that the Parasite we are now speaking of had appeared: the British Parasite had followed the British Butterfly, and was doing its appointed work. In 1875 it (the Parasite) had become quite common in the State of New York; and later on it was observed to be still on the increase.

The great benefit gained by natural helpers of this kind has caused it to be suggested that we should rear them. This matter seems rather hard to manage; also we do not often benefit much by upsetting the regular balance appointed; but it is often in our power to follow up a hint of this kind by remembering that when an out-of-the-way insect enemy has appeared, we may very likely be able also to introduce its regular check, and leave the results to follow in due course.

Fig. 100.—Parasite Flies of Wheat Midge maggot, nat. size and magnified.

The Parasite Flies figured of Wheat Midge show the shape of two other kinds of these minute Flies. The *Macroglenes* (Fig. 100, 1) is supposed, from its habits, to destroy the Midge grubs; and the *Platygaster* (Fig. 100, 2) has been watched in its operations of laying one egg in each Midge grub it attacks.

There are other kinds of Parasites of nearly-allied kinds, which we have not space to enter on here; but the general principle of preserving a useful amount of them is so important that, though it is a very difficult matter to protect them, *it is as well to be careful about setting on foot regular measures calculated to lessen their numbers.* It may be doubted whether in this way we do not suffer, rather than benefit, as much as is supposed, by *great* encouragement of birds.

We cannot tell accurately what amount of the small Parasite Flies are taken as bird food, for their small bodies are probably soon digested; but it appears reasonable to suppose that as we know some birds take them, that others also do so, and in this way do the reverse of helping. I would not for an instant suggest clearing away birds; but it would be well to bear in mind that the works of creation are founded on a principle of order, and of dependence of one part on another; and if we use such power as we may have to alter any detail, we are likely to suffer. We have altered the amount of food for insects by the enormous necessary increase in food crops; but it appears to me that to try to keep these insects in check by calling in bird help in legions,—which grub up the plant to be protected, and eat up the eaters of the insect foes, and likewise (when insect food fails the many mouths) betake them to the Wheat-ears,—is very much like bringing in the rats to drive out the mice.

The families of Bees, Wasps, and Ants, are included in another great section of this order, called the *Aculeata*, because they, or most of them, are furnished with a sting, much resembling in appearance, and pain of application, a needle; known in Latin as *Acus*.

These have been written on for so many years that we need not enter on them at length; but it is well to observe that the Hive Bees, the social Wasps, and social Ants, are remarkable for much of the work of the community being carried on neither by the males, nor as a regular thing by the large females, which are commonly known as queens, but by a large body of abortive females, or neuters, commonly known as "workers."

In the case of the Queen Bee we have a clear instance of the way in which different food and accommodation acts in altering, or rather in fully developing, the powers; and gain matter for thought, at least, that a precisely contrary treatment, such as compressing, starving, chilling, &c., brought about by common farming measures, will not (or probably may not) be without effect in stunting the growth, and otherwise lessening attack.

These Bees and Ants, however, belong to a different class of farm insects to those we are now considering; therefore we had better not pass from our special subject, and for the same reason we need not attend to the three following orders:—The Bee Parasites (*Strepsiptera*), which are generally almost microscopic; the Caddis Flies (*Trichoptera*), which spend their maggot life commonly in cases, shells, or bits of stick, or anything they can spin together, in our ponds or streams; or the Dragon Flies and their allies (*Neuroptera*).

Fig. 101.—Bee Parasite.

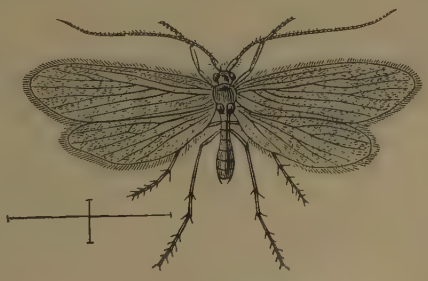

Fig. 102.—Caddis Fly.

You will observe that the *five* orders which we have considered at

some length have one great point in common: they are all quite different in the first state (as grubs) to what they are in the second (as chrysalids), and to what they are as perfect insects; also that in the chrysalis state, even if the limbs are visible, still they are not able to use them; and thus we have one clear season for measures of prevention, which it is well to make the most of.

Further, that each one of these orders—the Flies, the Fleas, the Beetles, the Moths, and the Sawflies and Parasite Flies—have for the most part a regular shape for the grub, chrysalis, and perfect insect, by which you may know them from those of other orders. You may know a Fly grub, chrysalis, and perfect Fly, with certainty, from a Beetle grub, chrysalis, and perfect Beetle. We have seen that the grubs may be known for the most part by the absence, or by the number, of feet or sucker-feet; the chrysalids by being in cases, or in a skin of thin cement, or by the limbs being visible; and the perfect insects are easily known. There is a difficulty about some of the chrysalids of the Wasp tribe resembling the Beetles, but this is rather a scientific than a practical matter, for the place you find them in often shows what they are.

The remainder of the orders of insects which we have to consider are much more easily known, because from the time they begin their life they are so like the parent insect in everything, excepting the absence of wings, that they commonly go by the same name.

We will consider some of these at our next meeting.

# LECTURE IX.

## APHIDES, SCALE INSECTS, &c.

(*HOMOPTERA.*)

HOP CUCKOO FLY, BEAN AND TURNIP APHIS, &c.; APPLE SCALE.


FIG. 103.—Bean Aphis: 1, infested Bean shoot; 2 and 3, male, nat. size and magnified; 4, female.

WHEN we began our work we noticed that insects were divided into thirteen sets, known as orders; and also that it was only a part of this number of orders that we needed to study for farm use.

Now we have observed that (besides three orders we need not study especially) there are five (namely, Flies, Fleas, Beetles, Moths, and Butterflies, and the order containing the Sawflies and Parasite Flies) which it is well to know something about, and though I have not the power to put the subject before you with the clearness and force I could wish, and it deserves, yet I have tried to show the points in these orders that are most important for working use.

Of the five orders which remain it will, perhaps, be best only to enter at any length on the one which includes the Aphides and Scale Insects, with merely a slight mention of the four other orders, which are much less important to us in this country. If we try to give more than just a mention of these, it will in this short time be more confusing than useful.

These four orders are those containing Grasshoppers, Crickets and Cockroaches (*Orthoptera*), Earwigs (*Euplexoptera*), Thrips (*Thysanoptera*), and Plant Bugs (*Hemiptera*). See figures in Lecture II.

The insects of these orders, as well as most of those of the order of *Homoptera*, which includes the Aphides, commonly change so little in appearance during their lives, that from the beginning of it they may be known by their likeness to the parent insect, and commonly are called by the same name. The chief difference is that at first they have no wings: if you will take a dead Grasshopper and pull off its two pairs of wings, you will see that,* excepting in size, it is very like the newly-hatched wingless ones, which we should call *larvæ*, if we want to describe them scientifically. This first stage, without any wings, answers to that of the grub, or caterpillar, or maggot, in the orders we have noticed. During this stage the insects eat and grow, and moult their skins, just as caterpillars do. As time goes on the wings begin to grow; and when the moult of the skin shows this is taking place then they are in the second stage, which answers to that of the chrysalis. Like the chrysalis of the Beetle or the Moth the wings are forming; but, unlike it, the legs are in a state to use, and commonly are used actively; the mouth also, be it of jaws or a sucker, is in working order, and very fully employed. When the insect is perfect within, it moults again, and appears with the full amount of limbs, and all the powers to which it ever attains.

* See Figs. of Locust, p. 28; Locust larva, p. 9; and Mole Cricket and larva, pp. 28, 145: all of which belong to the same order as Grasshoppers, namely, *Orthoptera*.

If you will catch a Grasshopper when it is about to moult, you may easily see the method of the change. When I have seen it the operation took twenty minutes. The back of the insect, or rather of its old skin, cracked, and through the opening there came out, very slowly and carefully, the insect from within. Each portion was drawn out in orderly succession, until everything, horns included, was free, excepting the long leaping legs,—the hindermost of the three pairs. These were left till the last, and seemed to need the utmost care and management to get them safely out of their tightly fitting covering; but they came out all right, and the real insect and its cast skin stood, as almost precise counterparts, side by side.

It is useful to know exactly how this change occurs,—to see it for yourselves, and to be able to show it to your pupils,—because though the little wingless insect vermin may be doing no great harm, as a few here and a few there, yet they will grow bigger presently; they will by no means give us a season of peace in the middle of their lives, and afterwards they will be able to lay eggs, and will multiply. It is, therefore, well to know and to be able to show that the little creature we hardly see is the same that will by-and-bye (if it is, say, an Aphis here, or a Locust in warmer countries) cause broadcast loss and trouble.

This order which includes the Aphides, Scale Insects, Cuckoo-spit Flies or Froghoppers, and some other hurtful kinds, is known as that of the *Homoptera*, or "similar-winged," from the wings being alike in texture (they are thus distinguished from the *Heteroptera*, or "dissimilar-winged," the Plant-bugs, which have a large thick leather-like patch at the lowest part of the upper pair of wings). They do not feed by biting, but by suction. The upper and under pairs of jaws are lengthened into long bristle-like growths, and enclosed in the lengthened lower lip. The whole apparatus forms a kind of beak, by means of which the insect pierces the soft parts of the plants on which it feeds, and draws out

the juices. Thus it not only hurts the plant by sucking away the sap, but also does great harm by the numbers of little holes which it pierces in whatever part it attacks.

The insects of this order differ widely in form; from that of the Scale Insect, fixed like an oyster- or mussel-shell on the bark, to the Cuckoo Froghopper springing in its headlong leaps, with its long legs trailing far behind it; and an idea of their appearance will be given much more clearly by figures than descriptions. Some, also, are so much alike in their first stages, that it is of use to observe that, as in the order of Beetles, the chief *sections* are classed by the number of joints of the feet.

The Froghoppers or Cuckoo Flies, some of which are very hurtful to Hops, are amongst the first section, with three-jointed feet. *Trimera.*

The *Aphides* or Plant-lice; the *Psyllidæ*, sometimes known as Jumping Plant-lice; and the small Snowy Flies (*Aleyrodes*), which do a good deal of harm to Cabbage;—belong to the second section, with two-jointed feet. *Dimera.*

The Scale Insects (*Coccidæ*) are the third section; these have feet with only one joint. *Monomera.*

In the first section the insects which concern us the most are the Froghoppers. These live in all their stages, as far as their history is known, by driving their beak into the attacked plant, and sucking out the juices. One well-known kind is the Cuckoo-spit, as it is called, which is to be found in its two first stages on many plants in a mass of froth, which it has caused. It is said sometimes to do a great deal of harm; but I have found that merely giving the attacked plant a hard watering from overhead easily cleared off both the froth and insect; and if this attack should occur the mere application of a good quantity of water by means of large garden-engines, such as are used in Hop grounds, would probably get rid of it at once.

Another kind of Froghoppers, known as Jumpers or Cuckoo Flies, does a great deal of harm in some years

to Hops. This is of a yellow colour, beautifully marked with brown; but to get a hold on it we need to know where the eggs are laid from which it hatches. A nearly-allied kind is stated to lay its eggs in autumn, either on the surface of the ground amongst grass, or amongst roots just below the surface. Another kind is stated to lay its eggs, by means of its ovipositor, in soft shoots.

Fig. 104.—Hop Frog Fly and larva; magnified, with nat. size.

This is an example of how thoroughly we need to know the whole history of an insect to be able to keep it in check by reliable measures at a paying rate.

Meanwhile in this case much is done, when it appears, by taking advantage of such of its habits as are plainly to be seen. Trays about six feet long, made of iron, are provided, well smeared with tar, and one placed on each side of the Hop hill. The Bines are shaken, and the Cuckoo Flies either fall or take their leaps for safety, and light on the tar, which promptly kills them.

The green Frog Fly of the Potato is another of the

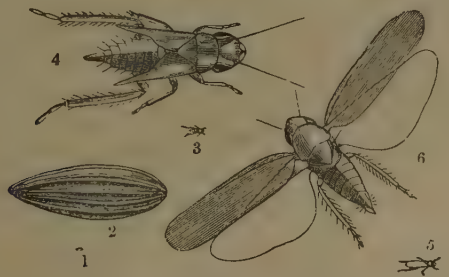


Fig. 105.—Potato Frog Flies: 1, 2, eggs; 3, 4, pupæ; 5, 6, Frog Flies: nat. size and magnified.

same kind of insects, and I repeat the figure just to give another illustration showing the partly developed wings in the state that answers to the pupa in this *section*.

The most important family in this order, however, is that of the Aphides, or Plant-lice. We know their general appearance well on Roses and Hops, Beans or Cabbage; and there seems to be hardly a forest, or fruit tree, or crop plant in this country, of which we can say that it is not infested by one or more kinds of Aphides, either above or under ground.

We know Aphides in a general way as small soft insects, having a head furnished with a beak, which is often half as long as the body, sometimes quite as long, or longer; the horns are commonly long and thread-like. The abdomen ends in a sharp, or curved, or variously formed tip, and often, but not always, bears on its upper part, near the end, a pair of horn-like tubercles, long or short, as the case may be. These tubercles are really hollow tubes, known as cornicles; what their use may be is not clearly known. Some have considered them part of the breathing apparatus; but, from the most recent and careful observations published, they appear to be additional means of excreting fluid.

The Aphis larvæ, sometimes known as lice, are much like their parent, only wingless; the pupæ have the beginnings of wings. In the perfect state, that is, where there is the fullest amount of development, there are males, and winged and also wingless females; but in some cases the male has not yet been observed, and sometimes there are only wingless females; likewise in some cases, as with the *Phylloxera vastatrix* of the Vine, there is a variety of form between the kind that lives under ground on the roots, and above on the shoots or leafage.

There is so much difficulty in the study of Aphides, and often such unnecessary trouble and confusion of mind as to what we need to know for practical use, that

before going on I wish to direct your attention to a few points which may be of practical assistance.

There is one large tribe of Aphides (such as we know, on the Hop, Turnip, Plum, &c.) containing upwards of 150 British species. There are also four very much smaller tribes, which live in various ways. Three of these may often be known by the kind of diseased growths they cause, such as the American Blight of the Apple, the swollen bag-like leaves of the Elm, or the Pine Apple-like Galls of the Spruce Fir; and one of the tribes feeds on roots under ground.

The first four of these five families may be known by a difference in the veining of the wings; and the fifth, which is a root-feeder, by never having, as far as is known at present, any wings at all.

If you will look at the foremost wings of an Aphis, you will see that there is one strong nerve or vein runs down it, near the front edge. If you will now begin at the body, and count the side nerves that start from this front nerve,—one, two, three,—you will find at the third nerve that, in the Turnip, Hop, Bean, or many others of our crop Aphides, this third nerve branches again into two forks.

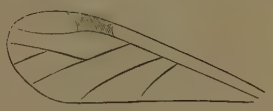

Fig. 106.—Fore wing of Aphis, of division of *Aphidinæ*.

All Aphides with these two forks to the third nerve belong to one great tribe, known as *Aphidinæ*, and have (as far as we can tell from those that have been studied) the same kind of life-history.

The *second tribe* has this nerve once forked. This includes only seven species, and the American Blight Aphis, *Schizoneura lanigera*, is an example of it. This is known as the *Schizoneurinæ*.

The *third tribe* has the nerve not forked at all. There are ten species of this: the Lettuce-root Aphis, *Pemphigus lactucarius*, is one; but it is not very important agriculturally. This division is known as the *Pemphiginæ*.

The *fourth tribe* (the *Chermesinæ*) has *not* got this nerve. There are only eight species: the Pine Apple Gall Aphis of the Spruce Fir (*Chermes abietis*), and *perhaps* the *Phylloxera* of the Vine, belong to this division.

The *fifth tribe* (the *Rhyzobiinæ*) is wingless, and found chiefly at the roots of grass or corn.

You see, thus, that with some few exceptions, which we need not enter into here, there are clear guiding marks through the mist and confusion of Aphis arrangement; and I must pause for a minute to say I think we are all greatly indebted to Mr. Buckton for his long and valuable work, which places the subject in a form which can be understood.

It has been well said, "Differences in structure show differences in habits;" and where we can lay our hand on some simple points like this, by which we can sort a mass of confusion into five well-marked divisions, it is well worth while to master the detail.


FIG. 107.—Cabbage Aphis: 1 and 2, male; 3 and 4, wingless female: nat. size and magnified.

To return now to Aphides.

The life-history of the chief division—the *Aphidinæ*, with the *two-forked nerve*, those which chiefly frequent our crops—may be given generally thus:—The wingless females, which are produced very soon after the males in autumn, lay eggs; sometimes singly, sometimes in clusters. From these eggs, in the following spring (or

possibly before), young Aphides hatch, which are all females; they go quickly through their changes up to the perfect state, and then they produce living young, which also are all females. These successive generations of living young, *still all females*, some of which are winged, some wingless, go on until, in autumn, the last generation occurs, which is of males as well as females; and the females of this, as we said before, instead of producing living young produce eggs, which start the next year's attack.

This is a general sketch of the history of the great tribe of *Aphidinæ*. This tribe includes the Corn Aphis (*A. granaria*), which infests the young stems of Corn and the growing Wheat-ear; the Green Dolphin, as it is called, of the Peas; the Collier of the Beans (see Fig., p. 127); the Hop Aphis, which in 1882 caused a loss of


Fig. 108.—Hop Aphis in two conditions; both nat. size and magnified.

more than a million and a half pounds sterling to this country; the Turnip and Cabbage Aphides; the Black Cherry-tree Aphis; and many other kinds too numerous to name at present; besides the white cottony Aphis of the Beech, and the genus known as Pine Aphides, some of which are cottony, and some have a hairy covering.

With regard to what we know at present of means of prevention, our best course is, *if we can*, to nip the evil in the bud by destroying the very first Aphides that appear. This plan is constantly carried out in field

management with regard to the Bean Aphis. When the Colliers, as they are called from their black colour, appear on the tops of the Bean shoots (see Fig., p. 127), these infested shoots are cut off. If the shoots and Colliers on them are destroyed, the attack, or at least a great deal of it, will be stopped; but if, instead of carrying off the fragments and destroying them they are only thrown on the ground, the Black Aphides will just walk or fly back again to the growing Beans, and the labour will have been in great part lost.

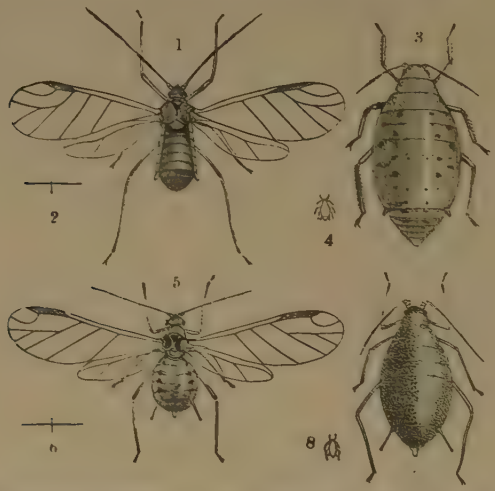


Fig. 109.—Turnip Aphides: 1, 2, 5, 6, males; 3, 4, 7, 8, females; mag.

This same plan is useful throughout the summer for all plants or trees, such as Apple, Plum, Cherry, or others, in which Aphides, or Green Fly, as they are often called, collect in great numbers on shoots, which may be cut off without hurting the plant. Thus if the shoots and Aphides on them are properly destroyed at once, we get rid of centres from which attack is constantly spreading to do present harm. Also we may thus lessen the amount of next year's attack. It is the autumn

brood of males and females which provide the eggs to start the attack of the following year; and therefore anything which lessens the *production of broods* is useful. The shoots, however, should always be destroyed at once; not merely thrown aside to wither gradually, whilst their infesting hordes gain wings to go home again.

A healthy, *yet not rank*, growth is one great means of lessening the bad effects of Aphis attack; as in the case of other insect attacks the plant is thus supported through its troubles. But there is a further reason. It has been found that Aphides come to maturity more rapidly where the plant growth is so stunted, or the Aphides themselves are so numerous, that it may be presumed the nature of the sap is different to that in the full flow of the healthy shoot, or the Aphis is rather shortened of its food. Necessarily maturity coming sooner the successive broods are more rapidly produced, and the numbers greater.

The number of remedies—such as solutions or mixtures of tobacco, paraffin, quassia, or other applications in the form of washings or syringings—are endless, but often fail in effect from the operator not being aware that in the case of many Aphides the skin is covered with a kind of mealy coating, which throws off watery application. Consequently it often happens that unless the washing lodges amongst the Aphides so as to kill them, or, again, the syringing is given with such force as to knock them from the plants, the insects are but little hurt. It is for this reason that soft-soap is so largely used, especially by Hop growers, for the washes: it is sticky, and thus *adheres* in some degree to the Aphides; also it may be made the *vehicle* of any other application with which it may be desired to poison the Aphides; and, thirdly, it is a good *fertiliser*, which, as we have observed, is important in Aphis attack.

The great thing, however, that we need to know in order to check Aphis attack is where and how each kind spends the winter. Meanwhile our best hope lies

in allowing as few shelters as possible in neglected bark (in fruit or tree attack), or at the roots of wild grasses round fields for possible shelter of grain Aphis, and (generally) being alive to the necessity of not letting everything drift without thought of the reasons of how or why things happen.

The Aphides of the remaining four tribes are much fewer in number; and of these the most important to us, in a farming point of view, is the American Blight Aphis, the *Schizoneura lanigera*.

The few kinds of *Schizoneura* that we have may be known by the *singly-forked* third wing-nerve, and also by the cornicles (or honey-tubes, as they are sometimes called) being wholly, or almost entirely *absent*. They live in very different places: one, for instance, is found on Black Currant roots in flocky matter, like that of the most destructive kind, which is the American Blight.

Fig. 110.—Winged "Woolly Aphis" and larvæ, much magnified. Infested shoot.

This Woolly Aphis, or American Blight, is chiefly to be found in neglected orchards. The Aphides shelter themselves for the most part in crevices of the bark, or where a bough has been injured, or under young bark healing over wounds; but they may be found on the

young shoots and the leaves, and are distinguishable by the white cottony material which surrounds them. I have also found this kind of attack on the rootlets. The piercing of the Aphis sucker causes the growth just below the bark to become swollen and pulpy; then the cells divide, and the bark above splits, and thus openings are formed, which give the Aphides new hiding holes; and the diseased growth from their punctures is continued, until large tumour-like masses are formed, and the trees are very seriously injured.

The best method of checking attack is to keep the bark of the Apple trees in such a healthy state—by means of proper pruning, and clearing away injured branches, and useless and cracked bark (and other measures), that there may be as few cracks and crannies, and half-healed spots, as possible; consequently as little as possible of the shelter in which this Aphis delights. Also when the white wool in any nook, or on any soft shoot in summer time, shows the presence of the pest, the shoots should be *at once* cut off, and some remedy should be well brushed or rubbed into infested nooks.

The number of different kinds of applications advised are almost beyond counting, but the principle throughout is one. Put anything which will stifle or poison the Aphides, without hurting the bark of the tree; and probably common soft-soap, or soft-soap with a little paraffin or tobacco-juice added to it, and well rubbed in, so that it may be sure to reach the pests in their sheltering nooks, will answer as well, or better, than most of the many suggested applications.

Some of the applications said to succeed should be applied (if at all) with great caution, or they may do more harm than good by soaking into the bark. Tar is especially to be suspected, for it is apt to melt in the heat of the sun; and turpentine, resin, and fish-oil, mixed and put on warm, and in fact anything that will thus choke the bark, is an unsafe application.

For attack below ground, the best treatment seems to be clearing away infested roots and soil round them,

and drenching the spot well with soft-soap washings or drainings from stables.

We have only six kinds of *Schizoneura*, and these may be known by the one forked wing-nerve, and by having either no honey-tubes (cornicles), or exceedingly small ones. See Fig., p. 138.

The next division hardly concerns us agriculturally. There are only about seven British kinds, and, like the above, they live in very various places: some are Gall-makers, and one does a great deal of harm at Lettuce roots. When this is at work it is desirable to water well with anything that will keep the soil thoroughly moist, and be favourable at the same time to growth; bearing in mind that below ground, as well as above, the great point in killing Aphides is to apply something that will choke up their breathing-pores, as mere water, or merely fluid applications, flow off them, unless special measures for flooding are adopted.* Also, when ground is known to be infested, it is very desirable to put on a killing dressing: a handful of fresh gas-lime, put into each hole from which a plant has been drawn, will do a deal of good; and any of the dressings we have noticed to clear out insect-life, applied from time to time, would be of service.

The simple point is not enough considered with regard to Aphis attack in the ground,—that unless by any chance infection was carried on plant or in earth, the insect must have gone down at some previous time to start the attack; and if we kept the earth in such a state that it *could not go down*, we should not have so much trouble. I would, therefore, strongly advise such application to the surface, and such care that there should be no cracks, or the earth dried away from the plant, or other means allowed for ingress of the Aphis, as might reasonably be expected to keep it out.

* It has been noticed by Mr. Buckton ('British Aphides,' vol. i., p. 35) that "complete submergence in water speedily kills most Aphides." An important observation, well worth consideration in the case of root-feeding Aphides.

This *tribe* of *Pemphiginæ* is generally known (see p. 144) by having *no* forks to the third wing-nerve; also by having the cornicles absent, or rudimentary.

The remaining *tribe* that is winged includes the *Chermes*, and (possibly) the *Phylloxera*. It is known as the *Chermesinæ*, and has no third wing-nerve (has three, *not four*, oblique wing-nerves), and no cornicles.

The *Chermes abietis* is one of the best known of this family from the singular Galls, like small Pine Apples, which it causes on Spruce Fir shoots.

FIG. 111.—Spruce *Chermes*. Female—pupa, eggs, and horn; all much magnified. Section of Gall.

The Larch *Chermes*, or "bug" (see Fig., p. 142), is sometimes very common and very injurious on Larch shoots. This is an example of a kind in which the female lives through the winter, and also never gives birth to living young; she is exclusively an egg-layer.

The *Phylloxera* is a world-wide trouble, but does not affect *us* agriculturally; therefore I am thankful not to be obliged to enter on what at present seems an unconquered difficulty.

The fifth tribe of Aphides feed mostly on grass-roots,

and are wingless; and should they be found troublesome, the use of the cultivator, plenty of gas-lime, and similar measures, would probably clear them out.

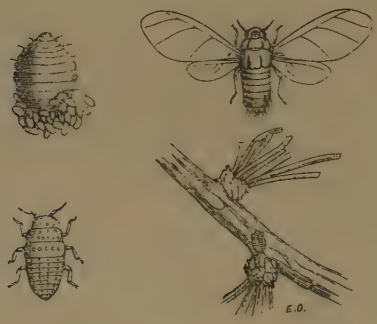

Fig. 112.—Larch *Chermes*. Female, with eggs; winged specimen, and larva; all much magnified. Infested Larch twig.

It is exceedingly difficult to give any clear view of Aphis life, or means of prevention, for few are known, excepting in cases where the plants are under cover, and therefore fumigation can be brought to bear. But the principle throughout appears to be this:—Check attack by diminishing lurking-places, and also by pruning off and destroying infested shoots and parts of plants, or infested leaves (as with Cabbage), as much as you can; and where you can bring washes to bear, use soft-soap as a foundation; but where the application may be run into the ground, and thus remain round the insects, ammoniacal water, or drainings from stables, lime-water, or other drenchings poisonous to insect-life, and that will not hurt the plant, have proved useful.

The Scale insects require a few sentences.

These at first sight look very unlike the Aphides; but if you look at some of the Aphides, of which the wingless female is little more than an almost motionless lump of egg-producing matter (see Fig. of Larch Aphis),

you will see a great resemblance to the *Coccidæ*, which are without the hard scaly covering, from which this section of the order that we are studying takes its name of Scale insect.

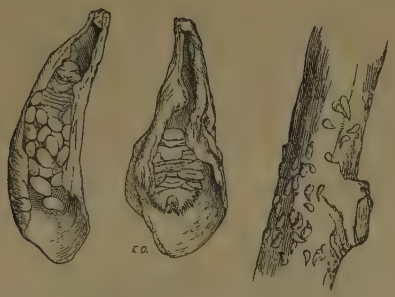

Fig. 113.—Apple Mussel Scale—female and eggs; magnified. Twig, with Scale: nat. size.

In the case of the Apple Mussel Scale (*Aspidiotus conchiformis*, Curtis), which is sometimes very hurtful in orchards, this shell-like husk, which is in shape like a minute mussel-shell, adheres firmly to the bark during winter; and under it, but not attached to it, there lies the dead body of the female Scale, and fifty or more eggs. In spring these hatch, and from them come small white flat insects, furnished with eyes, horns, six legs, and a sucker. These are very active at first; but presently each Scale larva runs its sucker into some spot it can pierce, begins to feed, and ceases to move. A secretion of waxy material takes place on its back, beneath which the scale forms; and after various moults, and additions by secretion to the size of the Scale, the change of the insect under it takes place to the perfect state.

This, in the female, is to a shape like that of a globular flattened maggot, greenish in colour, without jointed limbs, which lays eggs, and dies.

The males (I believe, in the present case, first observed

not long ago by Prof. Riley) have one pair of whitish wings, and no proboscis.

The best methods of getting rid of these Scales are to prune off infested boughs, where this can be done. Where it cannot, rubbing off the Scales by means of cloths or brushes, after moistening the bark with water, or scraping them away with a knife, gets rid of many; and, generally, the same kind of remedies are useful as are applied for American Blight, such as soft-soap, with some mixture of paraffin, kerosine, or other addition, which may stifle the Scale insects which have been disturbed, and make the bark unsuitable for attack.

NOTE.—The *Pemphiginæ* have usually no fork to the *third* wing-nerve; but in the case of the very small *Thelaxes dryophila*, sometimes found on Oak, this third oblique wing-nerve *has* one fork. The history of Aphis life is so involved that it is very difficult to convey any plain and clear general view; but in the above short sketch I have endeavoured to give a correct abstract of the present state of information on the subject, following the classification given in Mr. G. B. Buckton's admirable work, 'Monograph of British Aphides.'

# LECTURE X.

## LOCUSTS, THRIPS, PLANT BUGS, &c.

*(ORTHOPTERA, THYSANOPTERA, &c.)*

LOCUST EGGS, CORN THRIPS, &c.; JULUS WORMS AND RED SPIDER.


FIG. 114.—Mole Cricket.* Eggs, larva of two ages.

FOUR orders still remain of those of which the insects vary little in appearance throughout their lives. Of these four we do not need to enter on that of the Earwigs, *Euplexoptera* (Fig. 115), for though injurious in gardens, it scarcely comes within our province. Nor do we need to enter on the *Orthoptera*, the order that includes

* The Mole Cricket sometimes does much harm by feeding on roots both of grass and other plants, but I have no personal knowledge of it as a serious field-pest.

Grasshoppers and Crickets, so far as injury to our Islands is concerned, but it is worth notice that we are now and then visited by the true Locust. The unsuitableness of climate makes it very unlikely we should ever be seriously troubled by this terrible scourge, but nevertheless some of the observations taken by the Entomological Commission of the United States of America, as to the effect of cold, and deep burying of the eggs, in retarding date of hatching, are of much practical interest to us, for the size of the eggs allows the specimens to be observed

Fig. 115.—Earwig.

Fig. 116.—Locust, and larva.

with certainty, and from what happens to them we may at least get hints as to what very likely happens with the eggs of other insects.

It is found essential to great amount of Locust

presence that the eggs should be healthy, and properly deposited;—that is, at the proper depth below the surface, and otherwise in favourable circumstances. The natural depth is an inch or thereabouts below the surface; it was found that from eggs placed two inches deep about a third of the young Locusts managed to make their way to the surface, but none came up from eggs buried *more* than two inches deep. Eggs hatched that were buried as much as twelve inches deep, and the young Locusts worked their way for an inch or two through the earth, but (as we just observed) did not come up to the surface; and at the time when these were hatched, eggs buried deeper than twelve inches were still unhatched.

It is further noticed that eggs placed deeper, though they remained unhatched whilst buried, were not harmed by lying underground, for on being brought to the surface they hatched at once. Further, it was found, with regard to the effect of warmth or of cold in hastening or retarding hatching, that the Locust egg will bear freezing, but that at a uniform temperature of 85°, the time required for hatching was 31 days; at a temperature of 50° the time needed was 116 days. Other dates are given shewing that so long as the warmth was considerable,—that is, not lower than 60°,—though the time of hatching was lengthened increasingly with the drop in temperature, yet it was not very greatly altered; but below 60° the time was much lengthened.

How far these experiments may apply to eggs of our farm-pests we cannot be quite sure till we have proved it, in each case, but if, as is likely, the eggs will hatch at a moderate depth below the surface, and the grubs perish because they cannot come up, we have a useful piece of information; and further, in the fact of eggs lying unhatched and also uninjured when buried deeply, we may have a reason for the occasional entirely unexpected appearance of some crop-pest in a single field, but nowhere else in the neighbourhood.

But however this may be, we have instances here of

the use of putting eggs in unnatural places and circumstances, and for this purpose no means are better than thorough cultivation of the land. Thus whilst—just as with weeds—a number of the eggs are turned safely down to a depth from which we may hope they will not come up again, others will escape, but there will be a certain quantity destroyed by what is termed desiccation or drying. If an egg which is naturally placed below the surface of the earth, is thrown out on the surface to the effects of air and sunshine, the fluid within will dry up, and the embryo within will consequently be destroyed.

The order of Plant Bugs includes both plant and water insects, which may be known by a kind of leathery patch at the base of the front wings "dissimilar" from the rest of the substance, whence the order takes its name of *Heteroptera*, or "dissimilar-winged." The long-legged insects known as water-measurers, which we see skimming about on the surface of ponds, and the Water Boatmen which by the help of their long oar-like front legs sweep through the water like insect skiffs, are common examples of the water frequenters of this division.

The Plant Bugs sometimes do harm by sucking the juices of plants, especially the *Lygus* (*Phytocoris*) *solani*,

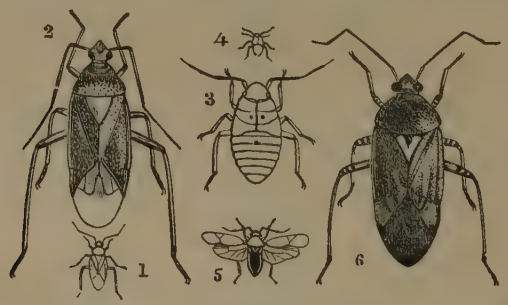


Fig. 117.—1 to 4, Potato Bug. 5 and 6, Hop Bug, nat. size and mag.

which attacks Potatoes, but they are, so far as I am aware, rarely injurious to any serious extent.

Some kinds of a longer narrower shape are to be found on Wheat and Barley. The Wheat Bug, *Miris tritice*,

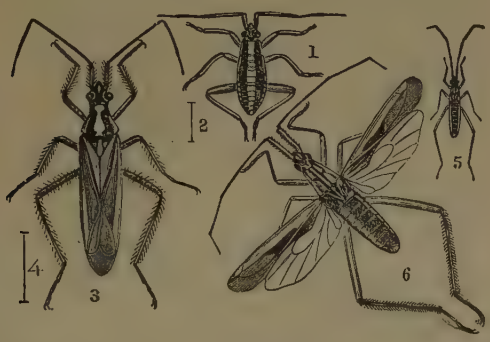


Fig. 118.—1 to 4, Grass Bug. 5 and 6, Wheat Bug, nat. size and mag.

has also often been found on grass in marshes; the Barley bug, *M. dolabratus*, is exceedingly common in Barley fields and on flowers of grass near them.

Some of these various out-of-door Bugs probably do good by means of their carnivorous habits; and with regard to the wingless kind which, to our misfortune, occasionally teaches us that feeding on animal juices by means of a sucker is a characteristic of this order, I think we need not enter on its prevention here.

The remaining order is that of the Thrips, *Thysanoptera*. These are very small insects, which sometimes do much harm to corn. They are nearly alike in shape in all their stages, but as they are scarcely large enough to be seen by the naked eye, the figure gives a better idea than description.

The perfect insect of the Corn Thrips (Fig. 119, 1 to 4) is blackish, but in the first state of larva or grub it is of a deep yellow; in the second it is of a paler yellow with whitish wing-cases.

These Thrips are to be found from June onwards in the growing Wheat ears, and sometimes in the sheathing leaves of the stem. They feed on the corn grain by

piercing into it with their sucker-like jaw apparatus,* and thus draw away the juices and cause the grain to shrivel.


Fig. 119.—1 to 4, Corn Thrips; 5 to 8, Potato Thrips and larva: nat. size and magnified.

Another kind, figured above, infests the Potato, drawing away the juices in the same way as the Corn Thrips; as do also the Aphides, Scale insects, Plant Bugs, and some others, which we have just noticed, with their variously formed sucking apparatus. In the case of the Potato Thrips, dusting with dressings of Lime and Soot, or other mixtures might do good, but for the Corn Thrips it seems impossible to find any application, as any of those used to destroy the Thrips would hurt the corn. The chief means of prevention seems to lie in clearing stubble, or in deep ploughing to get rid of Thrips which may be wintering at the roots of the removed crop, or in destroying wild grasses on which the eggs may be laid round the fields.

We have now in the last few days studied together some of the main points of Insect prevention,—not as I

* The precise character of the mouth of this insect has been much discussed. The result appears to be, that though it is shown to feed by suction, yet that it has a pair of long bristle-like mandibles (see Introd. to "Classification of Insects," by J. O. Westwood, vol. ii., p. 2). I have therefore in the list of orders, page 23, placed "Thrips," *Thysanoptera*, amongst the Insects with jaws.

could wish, for I have not the skill to put this subject, so important in its bearing on the food supplies of the nation, before you as strongly as it deserves.

But there is one thread runs through the whole matter,—that by observing the habits of the crop insects, and using remedies which lie in the common course of agricultural operations, under the guidance of a few *common sense principles*, we may in very many cases save our crops.

With regard to the direct study of Insect life, by observing the history of many insects in their different stages, you know clearly *what an insect is;* also that it goes through *three changes of condition;* and also that insects are *classed in large divisions called Orders*, according to the nature of these changes which they pass through up to the perfect state; and according to the nature of their wings when perfect; also that the *Orders are named from the nature of the wings.*

It is very important to know, and to be able to shew, that the manner of insect life is fixed according to regular laws, because there is still a kind of floating idea in many people's minds that insects come in some vague way; that they are formed from fog or mist, or water, or decay, and that, like the ghosts and hobgoblins of childhood, they are mysterious enemies which no one quite knows how to deal with. But once get the real history fixed as a fact, and then we know how to act.

It often matters very little whether we know the scientific name of an insect, but it matters a great deal when attack is going on that we should know the *nature* of the insects that cause it, and also *their habits in connection with the injured crop.* There are several kinds of Wireworms; several kinds of Daddy Longlegs; several kinds of Turnip-Flea Beetle. Each of these sets (so to call it) lives much in the same way as its brethren, and it is needless (for all farming purposes) that you should trouble yourselves about the scientific differences between one or other *of each set;* but it is of great importance that you should be able to tell whether *it is*

a Wireworm, or Daddy Longlegs grub (or so on), of some sort or other, that is injuring your crop, in order that you may use the right means to save it from the insect; and I trust that our work of the few last days will enable you to tell what orders such crop insects as you will commonly meet with belong to,—that is, whether they are Flies, Beetles, or so on; but to refresh your own recollections, or for simple plain teaching, I would advise you presently in your further study just to take each Lecture separately, and look *at the figures*. You will thus see, and be able to fix firmly in the minds of those who come to you for information, what are the main points of an insect (of whatever order you are looking at) *in each stage*.

Say it is the order of Butterflies and Moths you are looking at, your pupil cannot fail to notice that the caterpillars have commonly three pairs of claw-feet, and one to four pairs of sucker-feet, under the body, besides the *caudal* pair; also that there are two slightly different forms of chrysalis, belonging respectively to Butterflies and Moths; and also that the shape of the horns of the Butterfly differs from the many shapes of those of the Moths. If you had tried to explain this without a picture, the pupil would probably have been without an idea of what you were talking about; but one glance at the successive pictures will have told him at once what are the main points of a Butterfly or Moth, and its caterpillar and chrysalis.

The object of minute scientific descriptions is, that we may have a correct knowledge of the appearance of what is described; but there are few who can tell nearly as well from a description as from a figure what the described thing is like, and often a wrong idea is thus established. I would, therefore, suggest that in your first instructions to pupils you should teach as much as possible by the real specimens, if you can; otherwise by means of good figures. Also, when you need in field work to make out what insect it is which is injuring a crop, I would strongly advise you not to harass yourself by doing what is called,

"looking out the *insect*," but take the state of the crop as the starting-point. Have a book with descriptions of the common crop *attacks*, and a good number of figures, both of the injury and the insect that causes it. Then look out the crop in the index, turn to it in the book, and turn over the pages relating to attacks to that crop until you come to a picture or description that suits your own attack; and so you will soon know clearly (if it is one of the commonly injurious kinds) all that you need to know, or is known about it, instead of after long delay and trouble still being quite uncertain whether you are right or wrong. There are not very many attacks that are commonly injurious to a serious extent to food crops, fruit, and timber, in this country; probably if we say two hundred that would be quite an outside reckoning; and many of these you may know just as well, or better, by the state of the attacked vegetable as by the appearance of the insect.

There is one more point of farm insect study I wish again to draw your attention to. Our object here is to *save the crops*, and to learn and teach whatever we can on this subject in the very plainest way. Plants, insects, manures, farm implements,—all have to be thought of and spoken of; and in every case it is *highly desirable* to use the words that will be *most certain to be understood by those we are speaking to*. In regard to the insects I would strongly advise speaking of them by their commonly used English names; but still, with regard to the scientific names, it is very desirable to observe and show our pupils that these have a very precise meaning. Just as in the case of the orders, there is a distinct serviceable meaning for each name; so is there in many cases for the names of the lesser divisions; and it is desirable for those who teach to make themselves acquainted with the meaning of these words, as thus, more likely than not, they will be put in possession of some special point, some leading peculiarity of the insect or of the division, be it genus, or family, or order, to which it belongs.

These names may or may not help us practically; but it often happens that the second name—the specific name, as it is called, because it is used only to one species—describes some point of marking or colour, or of the kind of plant which the insect mainly frequents, which is very convenient to know. In the case of Aphides, for instance, they are often named after the plant which they infest; and with this tribe, especially, running down the columns of an index for the plant name often saves much time and trouble, where we are at a loss amongst the scientific insect names.

With regard to gaining information of serviceable methods of remedy of attack when it is present, it is of great use to benefit by the collected opinions of many farmers (of practical and scientific men), and their experience as to different methods of treatment that answer on different soils, cannot fail to be of most excellent service; but still it should be borne in mind that each man by a little observation of the method of attack, which is often only too plain, and a little quiet thought as to what measures can be brought to bear, might often help himself very effectually.

With a slight knowledge of the habits of insect-life, added to his own of the agricultural measures that could be used to destroy the pest, or at least lessen the effect of its ravages, each grower would be fairly able to cope with attacks as they occurred; whereas if he depends only on advice, besides the damage from delay, he is very likely to get suggestions not suited to the particular circumstances. The farmer may not know the history of the insect; but, on the other hand, the entomologist very seldom knows all the practical workings of growing a crop, which it is necessary to know before advising measures which can be depended on to answer at a paying rate.

In many cases the different items of treatment which go to make up good farming will of themselves keep down a great deal of insect attack. By good cultivation of the surface, and proper as well as liberal manuring,

by rotation of crops, and clearing fields and borders of useless trash and weeds, we turn out a great quantity of the pests which are harbouring in the ground, and also ensure a good healthy growth, such as will support the crop under moderate attack; and by the rotation of crop and absence of weeds we are often able to present starvation to our grubs, as many of them will only (or perhaps we should say, *can only*) live on special food.

These are the broad principles which will be sure to be of use,—we shall not be free from insects any more than we shall be free from weeds; and we need a great deal more solid field information about the habits of crop insects (and experiences of paying means of prevention) before we can think we have them thoroughly in hand. Nevertheless the last few years have added enormously to our information, and have shown us how at least we may greatly diminish the amount of injury our crops suffer.

I have not entered on details of the amount of this injury per acre to special crops, for our time has been more than filled; but the fact of the Hop failure through Aphis blight in 1882 causing a loss of over a million and a half pounds sterling, and the loss on the Turnip crop by Turnip Flea Beetle in 1881 amounting to fully, or to more than, half a million, may be taken as some slight guide to what is going on.

From insect injury, and from injury by what are described as "insect allies," the losses we suffer yearly are a most severe drag on the resources of the growers, as well as a national loss.

And now, before we part, I wish just to say a few words on some of the crop attacks commonly classed with those of insects, to show how they may be kept in check by the same kind of measures.

Perhaps the worst of these are the attack of Slugs; of Red Spider; and of the Millepedes or Julus worms, often known as False Wireworms.

The Julus worms, or Snake Millepedes, belong, like the well-known Centipedes, to the order *Myriapoda*, or

many-footed, very nearly allied to insects, as they are formed of a succession of rings, and breathe by means of tracheæ, but differ from them in having much the same appearance throughout their lives, and (markedly) in never having wings.

They are stated to feed on decaying as well as living animal substances, such as small worms, slugs, and grubs; as well as on decaying and living vegetables; and one or other of the various kinds attack Carrots and Potatoes, Cabbage roots, and roots of Kidney Beans, as well as roots of other crops grown in gardens; and also are sometimes found in great numbers at the roots of Wheat.

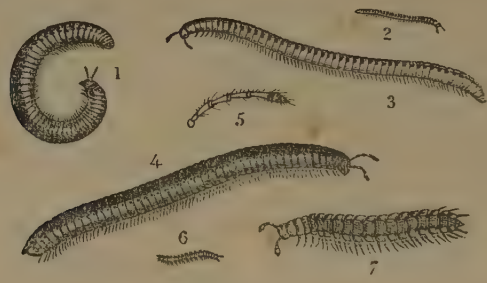


Fig. 120.—1-3, 4, Snake Millepedes, magnified (2, natural size); 5, horn, mag.; 6 and 7, flattened Millepede, nat. size and mag.

The females lay their eggs in the ground from Christmas until May, and the young *Julidæ* live two years before they are perfect, during which time they grow and change their skins five times, but remain (as observed above) the same in appearance, excepting in increase of the number of the legs.

The kind known as the London Snake-millepede (1, Fig. 120), from having been specially observed near London, has, when perfect, about 160 legs, placed in two pairs on each segment.

The Snake-millepedes are to be found under clods of earth and stones, and under rubbish, such as bricks and

pieces of wood, as well as in moss, or under bark; and I have found the flattened Snake-millepede in heaps of leaves blown together by the wind; also they are said to propagate most freely in undisturbed ground. Therefore it would appear that thorough cultivation of the land, removing rotten roots from infested ground, and also removing all the rubbish under which they shelter, would be good treatment; likewise good dressings of fresh gas-lime on infested ground could not fail to be of service.

The small spinning mite, known as the "Red Spider," belongs to the class of Spiders, or *Arachnida*, distinguishable from that of insects by the creatures commonly having eight legs, and in some cases having the head and fore body, in some cases the head and the whole body, united in one piece.

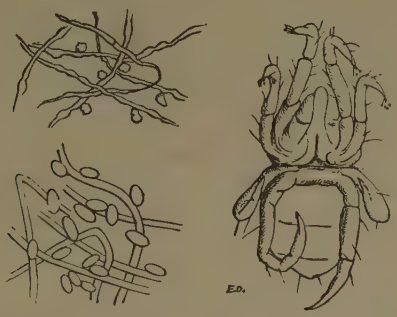

FIG. 121.—Red Spider, eggs and web (moist and dry); all greatly mag.

The "Red Spider," though hardly large enough to be seen with the naked eye, is a constant trouble, both in gardens and Hop grounds. It spins a fine web over the leaves or other parts of the plant it attacks, and amongst these threads it fastens its eggs, and under their shelter the young Red Spiders are protected.

The worst attacks of these mites take place in dry seasons; and the best remedy is considered to be washing the infested plants with soft-soap, applied by means

of field washing engines, or lesser power, as may be requisite.

During winter the Red Spider shelters in crannies, under stones or clods, in cracks in Hop-poles, or, in fact, in any convenient nook; and where it is present to a very injurious extent on wall trees, I have found that rubbing the bark thoroughly with soft-soap, or applying a mixture of gas-lime and soft-soap thoroughly, but not roughly, rubbed on by hand, did great good. A good dressing of gas-lime was also laid in a line at the bottom of the wall to keep the mite from crawling up, and thus the trees were cured. Sufficient moisture to ensure a vigorous growth appears an important means of prevention of attack.

Slugs and Snails are most terrible pests, but need not be quite so bad if it was borne in mind that (however urgent the need may be) the precise time when the crops are in the tender growing state, which most attracts the Slugs, is the time of all others when it is almost impossible to do anything on a good scale to get rid of them. In gardens a very much more thorough clearing of all their shelters would do good; but the remedy of sprinkling lime *slightly* is often a mere waste of time, on account of the lime slaking so quickly that unless it falls on the Slug it very likely does little or no good at all. The Slug has a power of casting off a kind of skin of slime, and thus getting rid of any obnoxious dressing not strong enough to kill it. In this way lime, salt, soot, or other similar applications, often fail in effect. But the Slug has not power to *continue* the process many times; and where the application has been *continued* at dawn and dusk for a few times it has proved successful.

When land is free a heavy dressing of gas-lime, or alkali waste, will kill even the Slugs; but, as with other pests, thorough attention to clearing out their shelters and breeding-places, and cultivating the ground so as to turn up the eggs, although it might not cure, would lessen the evil.

And now, once again, with regard to the subject of this little book, I wish to point out that power of prevention of insect attack does not lie in the mere knowledge which may enable us to tell the name of an insect, but in the knowledge of its habits, which will suggest to the practical agriculturist, in many cases, how to counteract these *directly* by measures of husbandry; or *indirectly* how, if we cannot get rid of the attackers, we may at least carry the crop through attack.

I trust that, though these few Lectures are but a slight fragment compared to the mass of information that is needed, they may be, at least to some extent, useful; and it would be the greatest gratification to me if they should in any degree induce others to take up the work more competently than myself. And in this view I will venture to give my own ideas in the words of one of our greatest thinkers:—He who would thrive in serviceable study "must, as with one eye, survey the *natures* of things, and have the other turned TOWARDS HUMAN USES."

# GLOSSARY.

*Alæ.*—Wings.

*Alate.*—Winged.

*Alula.*—Small membranous appendage to the base of the hinder edge of the wings of *Diptera* (two-winged flies).

*Antennæ.*—"Horns" or "cranial feelers" placed in front of the head; various in form, sometimes thread-like, and longer than the insect; elbowed; with a club of leaves; also saw-like, feathery, and many other forms; in butterflies somewhat like pins.

*Apterous.*—Without wings.

*Cauda.*—Tail.

*Caudal prolegs.*—Sucker-feet attached to the tail-segment of many kinds of *larvæ.*

*Chrysalis.*—A term applied to the *pupa* or inactive stage of life of various insects, chiefly butterflies and moths.

*Clypeus.*—Portion of the front of the face above the upper lip.

*Cocoon.*—A case, formed of silk or other materials by various kinds of *larvæ*, commonly for protection whilst they change to *pupæ.*

*Coxa.*—The hip; the first chief division of the legs of perfect insects, between the *thorax* and the thigh or *femur.*

*Elytra.*—Horny wing-cases—term commonly applied to the upper wings of beetles.

*Eyes, compound.*—The common form placed on each side of the head, and composed of a large number of separate eyes or lenses placed side by side.

*Eyes, simple.—Ocelli;* minute single eyes placed on the crown of the head.

*Feelers.—Palpi;* small appendages on the lower jaws and lower lip.

*Femur*, plural *Femora.*—Thigh; second chief division of the leg.

*Haustellum.*—Term applied to different kinds of insect-mouths formed for suction.

*Halteres.*—Poisers; short appendages, often like slender pins, to be found in two-winged flies, taking place of the absent hind wings.

*Horns.—Antennæ;* organs of various shape placed on front of head.

*Imago.*—Insect in perfectly-developed stage, as butterfly, fly, beetle, &c.

*Labium.*—Lower lip.

*Labrum.*—Upper lip; this is placed vertically over the lower lip, with the two pairs of jaws placed horizontally between the two lips.

*Larva.*—First active stage of insect life, as caterpillar, maggot, &c.

*Legs.*—In the perfect insect, formed of four chief pieces,—hip, thigh, shank, and foot; with a small piece, called the trochanter, between the hip and thigh. In larvæ, short legs of various forms, and sucker feet, or prolegs.

*Mandibles.*—Upper jaws, placed horizontally opposite each other beneath the upper lip.

*Maxillæ.*—Lower jaws, placed similarly to the above, just below the "mandibles," and furnished with feelers; thence called feeler-jaws.

*Maxillary palpi.*—Feelers on the lower jaws.

*Mouth.*—Formed of six pieces, an upper lip (*labrum*), lower lip (*labium*), with two pairs of jaws opposed horizontally between them, of which the upper pair (mandibles) are often strong, and serve for biting with; the lower pair (*maxillæ*, or feeler-jaws) are usually smaller and weaker, and are furnished with feelers or *palpi*, as is also the *labium*. In butterflies, Aphides, &c., that have sucker-mouths, some of the above-mentioned portions are variously altered in shape.—See *Proboscis*.

*Ocelli.*—Minute single eyes, usually three in number, fixed on the crown of the head, commonly known as simple eyes.

*Oviparous.*—Producing eggs.

*Ovipositor.*—Instrument whereby the female insect lays her eggs.

*Ovum.*—Egg.

*Palpi.*—Feelers, placed on the lower jaws and lower lip.

*Poisers* (see *Halteres*).—Appendages in the place of the hinder wings of the Diptera.

*Proboscis.*—In butterflies, altered lower jaws forming the spiral trunk; in two-winged flies, the altered lower lip enclosing the piercers.

*Prolegs.*—Sucker-feet, whereby caterpillars and other larvæ hold firmly to the substance they are placed on.

*Pulvilli.*—Cushions beneath the feet of flies, and some other insects.

*Pupa.*—Second stage of insect-life, in which it is often inactive, as with the chrysalis of butterflies.

*Rostrum.*—Sometimes called snout, when applied to the prolonged front of the head of some kinds of beetles; also used as well as proboscis for the altered *labium* of Aphides.

*Scutellum.*—A name sometimes applied to a portion of each segment of the *thorax*, but especially to the triangular shield-shaped plate between the base of the wing-cases in beetles and bugs.

*Segments.*—Rings of which an insect is composed—considered to be thirteen, including the head.

*Spiracles.*—Breathing-pores placed along sides of insects, or at the end of the tail, by means of which the air is drawn into or expelled from the *tracheæ*, or breathing-tubes.

*Stigma.*—A small thickened spot on the front edge of the fore wing of various kinds of insects.

*Sucker-feet.*—Prolegs; fleshy appendages, whereby *larvæ* hold firmly to the twigs, &c., whereon they are placed.

*Tarsi.*—Feet, the fourth chief division of the leg; being that on which the insect rests.

*Telum.*—Last segment of the abdomen.

*Tibia.*—Shank; third chief piece of the leg; between the thigh (*femur*) and foot (*tarsus*).

*Thorax.*—The three segments next to the head, known respectively as the *pro-*, *meso-*, and *meta-thorax*, of which in perfect insects the first bears a pair of legs, the other two each a pair of legs and wings.

*Tracheæ.*—Organs of respiration communicating with the air by breathing-pores (*spiracles*), and conveying it by means of smaller tubes throughout the body.

*Trochanter.*—A very small portion of the leg placed between the hip and the thigh.

*Ungues.*—Claws, or curved hooks, at the extremity of the foot.

*Viviparous.*—Producing living young.


Fig. 122.—Grub of Ground Beetle, *Calosoma sycophanta.*

# INDEX.*



* For Lime, Gas Lime, Salt, and other applications, which are of such constant use that the repeated mention can hardly be conveniently noted in the index, the reader is referred to the various main accounts of methods of prevention.

ERRATUM.

P. 167. *For* Currant Moth, *Abraxas grossulariata*, *read* Clouded Magpie Moth, *Abraxas ulmata*.

The Large Magpie, or Currant Moth, is very variable, and sometimes almost similar in marking to the Clouded Magpie, but in typical form it is rather larger and more distinctly spotted.—E. A. O.

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